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RAPID TRANSIT.

While the scheme for rapid transit in New York is yet in the toils of the politicians, and may finally be defeated through a Croker-Platt deal, Paris is more fortunate and is about to commence work upon an ideal underground rapid transit system. The plans, which have been approved by the government and now only require to be ratified by the Chamber of Deputies, provide for a tubular metal tunnel six and three-quarter miles long, with a diameter of sixteen feet. The motive power is to be electricity. In addition to this project is another for a subterranean network of electric roads like the underground system of London, which it is proposed to complete before the international exposition of 1900. London has already started on the construction of an electric underground system, and the scheme of still another is far advanced. In view of these measures being thus taken in Europe, it would be inexcusable for New York, the richest city in the world, to extend instead its present abominable system of elevated railways —a measure that would be against the almost unanimous wishes of its citizens and only in the interests of the Manhattan monopoly and its political hirelings. That the present underground bill is in danger is shown by the action of Senator Lexow and others in attempting to smuggle a bill through the Legislature that would not only indefinitely extend the elevated roads but effectually put off the prospects of real rapid transit by electricity. As we have remarked before, the adoption of an electrical underground system in New York means a great deal for the electrical industries. The undoubted superiority of electricity for the purposes of rapid transit thus demonstrated, it would not be long before other large cities would adopt the same method; of these we need only name Boston, Philadelphia and Chicago, whose needs are but little less than New York.

NIKOLA TESLA.

In another column we print a review and estimate of the work of Nikola Tesla from the pen of Lieut. Patten, whose own work, to some extent along similar lines, well qualifies him for the undertaking. While much has been written of Tesla and his achievements, it has been almost invariably from a popular standpoint, and, as far as we know, this is the first attempt to give a critical estimate. The great beauty of the Tesla experiments, the novelty of the subjects dealt with, the charming literary style and picturesque personality of the gifted inventor himself—all those have distracted attention from the technical and commercial features which, under ordinary circumstances, are the grounds upon which judgment is based. Perhaps another reason is that only recently has the opportunity been afforded, through an exhaustive compilation of Tesla's writings, patents and of other material, to take a comprehensive view instead of only the partial one hitherto possible. One is naturally disappointed that nothing practical has as yet proceeded from the magnificent experimental investigations with which Tesla has dazzled the world, and, what is still more disappointing, that they hold out no definite hope of the realization of the great promise they were supposed to contain. On the other hand, it should be borne in mind that Tesla is not working as a commercial experimenter with only a view to the speedy coining of his results into dollars and cents. His attitude is more that of Faraday, who felt that the world would obtain most benefit from his genius if devoted to pure physical research, knowing that his discoveries would eventually have a

practical fruition. The whole hope of modern science may be said to lie in molecular physics, and it is through work like that of Hertz and Tesla that we will, if ever, penetrate its mysteries. While therefore the popular conception of Tesla as one working like Edison to achieve only practical results is wrong, the popular estimation in which he is held has nevertheless a real justification in his valuable labors, though these may not lead directly to the marvels expected.

WHAT DOES IT MEAN?

When such an eminent coterie of patriots as Governor Flower, Thomas C. Platt, Superintendent of New York State Canals Hannan et al., join forces in connection with an equivocal public measure, it is necessary for the public to be on its guard. The circumstances attending the granting of the recent canal electric franchise are so suspicious as to augur no good for the interests of the public or of the electrical enterprises with which the terms of the grant may interfere. The secrecy with which the contract was prepared and the haste of the Governor in signing it just as a bill was about to pass that would have taken away the power to make such a contract, have a significant bearing, which is rendered still more significant by such other names cropping up in connection with the matter as Hugh J. Grant, and Anthony Brady and Charles De Freest of Senator Murphy's entourage. If the question involved is merely the possession of a valuable franchise that will not conflict with present electrical interests, the matter is bad enough, as it concerns the gratuitous appropriation of what belongs to the public, and the monopoly of what should be left free for legitimate competition among all comers. If, however, it also involves—and this seems possible—the power to crush legitimate electrical interests now established along the route of the canal, the measure is little short of anarchy. That a government should thus place in the power of a clique the means to destroy private capital is monstrous, and that it should be done by what seems to be a low intrigue is a crime. It is but just to say that the officers of the Cataract General Electric Company claim that the State can at any time purchase the plant at an advance of 10 per cent., but it is also said that this proviso was left out or nullified in the franchise as signed. The scores of electric lighting companies along the line of the canal will hardly permit their interests to be jeopardized without an effort on their part to prevent it, and the outcome will doubtless settle the question whether the State can constitutionally make a free gift of its property for the purpose of setting up a monopoly to crush legitimate business enterprises, and incidentally whether the abuses of power condemned at Gravesend shall be permitted to flourish at Albany.

GENERAL ELECTRIC.

The annual report of the General Electric Company, which, with an analysis, will be found in the financial column of this week's issue, contains little that is reassuring. The best that can be said of it is that the statement is a frank one and does not attempt to bolster up false hopes. That the new directors will have to apply drastic measures before the company can be brought up to a point where it should be, is evident from the statement, and, we believe, expected by those most interested. One of the points that will have to be dealt with is the valuation of patents and franchises, which is placed at $8,159,264.02. Of the hundreds of patents owned by the General Electric Company we can recall less than a half dozen that are generally considered to have any great value; these are the lamp patent, which expires in November; the three-wire system patent, the feeder-and-main patent, and the double carbon arc lamp patent. Of the others many doubtless have a considerable intrinsic value, but—and this is the only vital point to consider in connection with their valuation—do they act as a preventive of competition to any important extent? There is an immense difference between a patent that involves a monopoly and one that can be merely quoted as a selling point. Of the assets $4,264,814.21 consist of plant and real estate, and $6,624,28c.08 of stores, manufactures, the value of work in progress, and cash, or there are, in round numbers, $10,889,000 of assets, representing values that are tangible and comparable to those of ordinary manufacturing concerns. Assets in stocks of manufacturing companies, such as the Brush, Fort Wayne and others, are $2,767,470.58; in stocks and bonds of local companies, $2,723,493.17; and in notes and accounts receivable (face value, $14,984,697.42), $9,525,303.63, or, in round numbers, $15,000,000 of stocks, bonds, and accounts, making with the other amounts given above, $34,c00,000 in round numbers. The liabilities, aside from stock to the value of $34,711,600, are $11,216,849 in debenture bonds and accrued interest on same, mortgages, and notes and accounts payable. This showing, unfavorable as it is on its face, is still more so on account of the indefinite value of the items that go to make up notes and accounts receivable, and of the stocks and bonds. Schedules of the latter are published, which permits of the valuation being checked; the former have been scaled $6,000,000, but taking into consideration the basis on which electrical business has been conducted, both on the part of the great companies and of the recipients of their favors, the real value of a great part of the debts that go to make up the $9,500,000 referred to is an extremely uncertain quantity. What the future of the General Electric Company shall be will depend upon the action of the directors. If they adopt the frank policy which their officers followed in preparing their report, sturdily face the situation and then apply the radical remedies necessary, the company may be again started on the road to prosperity. If it lays aside the hopes bound up in patents, which, instead of protecting have been the source of enormous legal expenses, and places its business on the same commercial basis that its great rivals have adopted, it may be necessary to largely scale its stock, but in return prosperity will almost undoubtedly be assured. The General Electric Company has been the last to recognize the changed conditions from the days when manufacturing profits cut little figure in the calculations of electrical companies, and when it mattered little if a huge and picturesque official personnel and corresponding office expenses were out of all proportion with the profits earned. Such a method of doing business recalls Canrobert's celebrated saying at Balaclava, ''C'est magnifique, mais ce n'est pas la guerre," and after its recent lesson we do not doubt but that the General Electric Company will now map out a policy which, though perhaps prosy, will be in accordance with true business principles. While the policy of the company has heretofore been such as to excite the most violent animosities and its total shipwreck would be applauded by many, the great part it has played in the development of the electrical industries will also be remembered and its rehabilitation welcomed by all whose path it has not crossed.

Subterranean London.

It gives an impressive idea what subterranean London is fast becoming, says the London "Daily News," to learn that on emerging from the river the new City and Waterloo line will, in its passage up Queen Victoria street, run for a part of the way underneath the low level main sewer, which in its turn runs along beneath the District Underground Railway. So that at this point in the city we shall have first a busy main thoroughfare, below that a steam railway, then a huge metropolitan sewer, then an electric railway, reaching its terminus at a depth of about 63 feet below the streets, and here it will communicate with another line—the Central London—which will lie at a depth of 80 feet.

Death of Paul Jablochkoff.

Paul Jablochkoff died at Saratoff, Russia, April 5. While M. Jablochkoff in recent years has had little influence on the industrial development of electricity, his work in the earlier years exercised a most potent influence, and as one of the pioneers his name ranks with Gramme and Siemens.

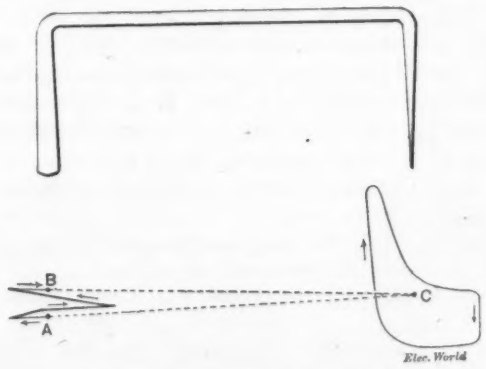
M. Jablochkoff was born at Serdobsk, Russia, Sept. 14, 1847. He belonged to a distinguished and well-to-do family, his father having been a member of the General Council of his province and his brother a distinguished military officer. Entering the military service he studied at the Russian Military Engineering and the Military Galvano-Technical schools, and in 1871 was appointed director general of the Moscow-Koursk telegraph lines on account of the particular aptitude he had shown for electricity.

His attention was first particularly drawn to arc lighting by the frequent failures of an arc light which he placed on the engine of the Czar's train as a safeguard during the commencement of the Nihilist propaganda in 1872. In 1875 he quitted the Imperial service, and the next year, having had placed at his service the Breguet workshops in Paris, after eight months' experimental work he produced the celebrated Jablochkoff candle, which may be said to have given the first great impetus to electric lighting through the then incomparable illumination it furnished to the Avenue de l'Opera of Paris. The Jablochkoff system soon acquired a world-wide fame, but after a few years was displaced by the modern arc lamp.

M. Jablochkoff at the same time took up the subject of alternating currents, and as early as 1878 showed a transformer system at the Paris Exhibition. He was also the pioneer in the use of condensers with alternating currents, and the original character of his genius is shown in many other inventions, such as that of a voltaic battery consuming coal, auto-accumulators, etc.

A Simple Instrument for Measuring Areas of Curves.

In a recent paper read at the London Physical Society by Prof. Henrici, he calls attention to the simple and ingenious "hatchet" integrator, which was invented long ago, but does not seem to be generally known. It is shaped like a staple, as shown in the adjoining cut, one limb terminating



A SIMPLE INTEGRATOR.

in a tracing point and the other in a curved blade like a hatchet. By moving the point from near the centre of mass of any closed curve, as *C* in the indicator diagram, up to the curve, around the curve once, and back to the starting point, the distance between *A* and *B*, the initial and final positions of the hatchet head, is a measure of the area of the curve. The instrument has been found very useful for indicator diagrams. No further information is given in the abstract in the London "Electrician," March 23, from which the accompanying cut is taken, but it appears that it is important not to have the length too short as compared with the size of the curve in order not to cause an error due to the difference between the arc and its chord between *A* and *B*; it is well not to have the instrument too high, as it then becomes awkward to handle; care should doubtless also be taken to have the hatchet edge in a direct line with the point. No information is given regarding the calibration of the instrument, but we suggest that it can be calibrated readily by measuring the area of a circle or square, whose exact area and centre of mass are known, thus giving the constant; the difficulty seems to be in the estimation of the centre of mass of an irregular curve. A very simple form of this instrument can be made by opening the large blade of a penknife for the hatchet end and opening the small blade on the opposite end halfway, using that as the point. Perhaps further information could be found in the original paper, which was read on March 9.

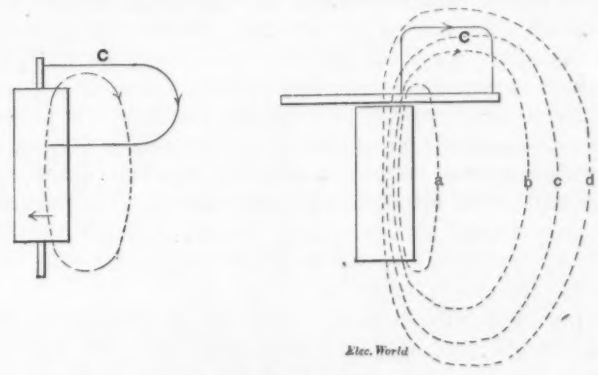
Unipolar Induction and Current without Difference of Potential.

BY A. G. WEBSTER.

There have recently appeared in The Electrical World several articles on two subjects that frequently appear in the guise of paradoxes in electricity and magnetism, and as the writers have not generally been contented with stating facts, but have felt constrained to "advance a theory" of their own, a few words more on the subject may not be out of place. It is my purpose to point out that the theories in question are unnecessary, and that some of the statements made are incorrect or without point.

The conditions necessary to the working of a so-called unipolar dynamo were clearly and correctly stated by Mr. Hering in his article of Jan. 13, but as he in the same article partially commits himself to one of the statements that I wish to criticise, namely, that lines of force from an electromagnet are stationary if the coil is stationary and revolve if the coil revolves, it will be well briefly to consider the simplest cases of so-called unipolar induction.

If we rotate a cylindrical permanent magnet about its axis (Fig. 1), and let the ends of a wire rub, one on the magnet



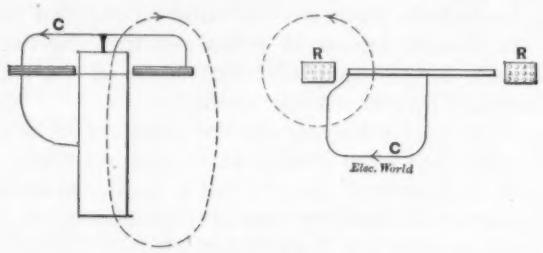
FIGS. I AND 2.

and the other on the axis, we get an induced current in the wire, in the direction shown by the arrowhead. In all the figures following, it will be supposed, when the contrary is not stated, that the rotation of the moving parts is in the direction of the hands of a watch lying flat on its back. The lines of magnetic force (drawn dotted), symmetrical in each case about a vertical axis, are supposed to go upward in the middle of the figure. The above is Faraday's original experiment. Let us now examine what role the rotation of the magnet plays. First, it is evident that it is merely relative motion of parts of the system that produces any effect. We shall therefore get the same current if the magnet remains at rest and the wire *C* rotates in the opposite direction about the axis. The cause of the induction is now, of course, to be seen in the continuous cutting by the moving conductor of the lines of force that cut it once, but not twice. The experiment may now be modified as in Fig. 2. A disc is fixed

to the end of the magnet, and against it rub the ends of the wire. As before, magnet and disc may remain fixed, and the wire may revolve. Now separate the disc from the magnet, and rotate it alone, the magnet and wire remaining stationary. The current is the same as before, showing that the rotation of the magnet has nothing to do with the matter. The induction may be considered to take place when the disc moves in the moving radius joining the ends of the wire, and depends on the number of tubes of force cutting the disc once, as does the line *b*. Lines which cut twice, like *a*, or which cut the wire twice, like *c*, or not at all, like *d*, contribute nothing. When the wire moves, the disc being stationary, the induction may be accounted for by the cutting by the wire, the same lines coming into play as before; hence the current is the same.

Now, thirdly, we may rotate the magnet, the disc and wire being stationary. Of course, we get no current. I say, of course; for, if there were any current produced, turning the magnet and disc in the same direction would produce a different current from that produced by turning the disc alone. This is, however, not the case.

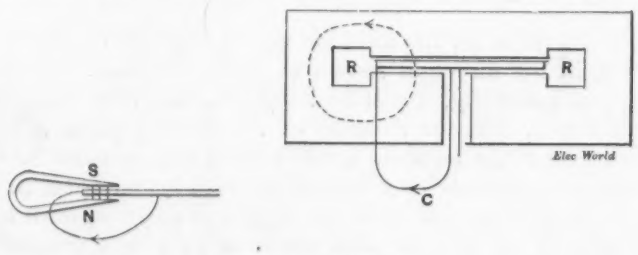
The above experiment is the converse of the Ampere-Faraday rotational experiment, shown in Fig. 3. Here the



FIGS. 3 AND 4.

wire *C*, traversed by a current, dips in a basin of mercury, corresponding to the disc above, and rotates about the axis of the magnet. If the wire be held still, the mercury revolves in the opposite direction. Rotating the magnet has no effect whatever on the motion. We accordingly see that the essential part of the phenomena of unipolar induction or rotation is two discontinuities in the motion of the conductor, or, in other words, two sliding contacts. It is the relative motion of the two parts of the conductor that figures in the phenomena, while the relative motion of the magnet does not enter into consideration at all. For instance, in the experiment last described, in one instance the magnet is at rest relatively to the wire *c*, in the other to the mercury or disc, the result being the same.

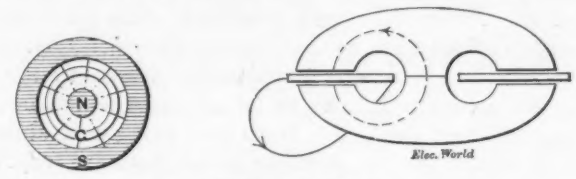
This effectually disposes of the question whether the field of a symmetrical magnet rotates with it or not by showing that it is a question devoid of sense, the answer being, to



FIGS. 5 AND 6.

use a favorite word of Lord Kelvin's, purely nugatory; for, the field being unchanged by the rotation, we cannot determine whether it rotates or not. A further example of what takes place in Fig. 2 is found in Lorenz's method for the determination of resistance in absolute measure, where, as in Fig. 4, a disc rotates in the field of a ring coil, *R*, the current being taken off at the axis and the circumference. This is the exact prototype of Forbes' "unipolar" dynamo, Fig. 5, except for the iron. The principle is identical with the original unipolar dynamo, Faraday's disc, Fig. 6, which, it will be observed, has two poles, like all unipolar dynamos. Fig. 4 may be called a non-polar dynamo.

This brings us to Mr. Bruce Ford's supposed mushroom dynamo (Fig. 7). The disc must now have a hole cut in it to prevent it from cutting the lines through the stem of the mushroom. This is merely Forbes' dynamo turned inside out, for if we cut the stem, make the disc without the hole, reduce its diameter and weld the edges of the mushrooms together, we get Forbes' machine. Fig. 7 is like the Siemens machine (Fig. 8), which has a tube instead of a disc



FIGS. 7 AND 8.

cut by lines of force proceeding radially from an enclosed pole, *N*, to an enveloping hollow pole, *S*. I hope I have now convinced Mr. Ford that, in Fig. 7, cutting mushrooms apart and revolving either or both will produce no effect, and that his theory is therefore superfluous. I have as yet said nothing about revolving the magnetizing coil, as it is *a fortiori* evident, from what has been said, that it makes no difference.

I now return to Mr. Hering, who, in the issue of Feb. 3, in answering a statement of Mr. A. Randolph, states that an unsymmetrical magnet in revolving does not necessarily carry its field with it, but the explanation of the working of the machine in question may be found in the strengthening of the fixed field (by the moving pole pieces). I confess that this seems to me to be a distinction without a difference. All that I have heretofore said relates to fields symmetrical about the axis of rotation. When, however, a piece of iron moves in a field of force, it is customary to speak of it as carrying its tubes of force with it, it being immaterial whether they are the same tubes in another place or whether the tubes in the other place have been strengthened by the iron which has come there. The idea of moving tubes of force has, however, been very fruitful, and in the hands of Poynting, Heaviside and Hertz has given us a convenient representation of the transfer of energy in space. It is noticeable that if we had had to do only with steady currents, the notion of moving tubes of force would never have arisen, as it would not had we had to do only with symmetrical fields, such as those above described.

(To be continued.)

India and the Electrical Conference.

When the committee which arranged the Electrical Conference at the World's Fair was discussing the matter, says the Madras "Times," it was proposed to put India on the list of invitations, but some member of the conference asked why "Indiana" should be specially represented and none of the other American States. Those present thinking India was short for "Indiana," accordingly struck it out of the list. That is how it came about that India was not asked to send a representative. Such is fame!

Telephone Communication in Different Cities.

From a German journal it appears that there are almost as many telephone subscribers in Berlin as there are in New York, Chicago and Philadelphia together; in London there are only about two-thirds as many as in New York.

The Advisability of Becoming an Electrical Engineer.

BY HENRY FLOY.

Not with the idea of figuring as a philanthropist, nor to discourage the ambition of future Edisons or Teslas, but because the future of any man is shaped largely by the selection of work made during his early years, and because there exists a misapprehension as to the opportunities open in electrical engineering, it has occurred to me that a brief statement of existing conditions, as I see them, might help to an intelligent decision those who are considering the advisability of becoming electricians.

The remarkable results effected through the agency of electricity, and the wonder which these results inspire in minds ignorant of the laws that govern electrical phenomena; the very rapid growth of the electrical business and the large amounts of money that used to be made in these lines, have all tended to produce a popularity for electrical engineering which at present is probably unequalled in any of the professional or technical callings.

Such expressions as "Electricity is in its infancy," "Electricity is to be the motive power of the age," etc., are quoted and requoted by the general public, not because they know anything as to the truth of the statement, but because it is the American nature to be tickled with novelties and to believe in anything that has the appearance of worth.

As a result of these conditions, there are at present a very large number of young men—and even some young women—who are planning to become electricians. Some of this number are preparing themselves more or less thoroughly by a course of training in classical or technical colleges—these I shall call "students"; the remainder—who may be called "artisans"—are working their way up from the practical or business end of the profession. When men of equal natural ability from the two classes come into competition, the former must eventually secure the higher positions, for the training secured in from three to six years of college curriculum cannot help but make them exact thinkers in addition to furnishing them a supply of theoretical knowledge which the "practical man" has failed to obtain.

Formerly there was considerable doubt as to the possibility of the "student" becoming a good all-around electrician, on account of the opinionated and conceited views apt to be held in regard to his own ability, which would make him unwilling to get down to the "dirty work." But this objection cannot be considered to hold now, as will be evident to any one who will take the trouble to visit electrical manufacturing establishments and see men of the highest training and ability, some of whom are already supplied with sufficient means to live comfortably the remainder of their lives, clothed in working jackets and performing tasks of the most menial character as patiently and as cheerfully as any of their less fortunate companions.

Immediately after graduation "students" are, of course, handicapped, because they lack practical experience, but after having obtained this, which they seem willing to do, it is but natural that they should outstrip men who have not received the advantages of a college training, and in very many cases, not even a high school education.

Possibly some may think that I overestimate the advantages to be derived from a college course, and therefore I refer directly to the catalogues of two of our leading universities, each representative of its class, to show what course of instruction a graduate from one of these universities has received.

Before admission to the course in electrical engineering at Princeton, it is required, after 1895, that the student shall be a graduate of the Academic Department, or shall have shown himself capable of such standing by examination. This course is designed to extend over two years, and, according to the Princeton catalogue, covers the following:

Course of Study.—First year: The mathematical theory of electricity, Mascart and Joubert: Treatise on Electricity, volume I, with references to Maxwell, Cumming and other authors. General electricity, volume IV. of Wullner—Experimental Physik. These courses occupy eight hours a week throughout the year. Elementary electrical measurements, with references to Stewart and Gee, Kohlrausch, Slingo and Brooker, Gray, etc. Two days in the week are left free for this work. Strength of materials and mechanism, each two hours a week, and theory of machines for three hours a week for half the year, are taken with the senior class in the Civil Engineering Department.

Second year: The theory of electrical measurements, Fleming: Alternate Current Transformer. Four hours a week for half the year. Mascart and Joubert: Treatise on Electricity, volume II. Four hours a week for half the year. Theory of dynamo construction, Thompson: Dynamo-Electrical Machinery, with collateral lectures. Technical applications of electricity in telegraphy, electro-metallurgy and electro-chemistry, electric lighting and transmission of power. Four lectures a week throughout the year. Advanced electrical measurements and electrical testing.

In addition to these courses a meeting is held once a week, at which reports on the current electrical literature are made by the students.

As an example of a high-grade technical school which insists upon a thorough training in shop work and mechanic arts, in addition to the theoretical work, I cite Cornell University. This college well represents those schools which hold that training for both mathematical and electrical engineers should be very much the same, their idea being that an electrician should have a very thorough knowledge of mechanical and steam engineering in order to succeed in his own profession. The work during the freshman year at Cornell covers the following:

French or German, higher algebra, trigonometry, analytical geometry, chemistry, drawing and shop work.

For the sophomore year, differential and integral calculus, descriptive geometry, electricity and magnetism, acoustics and optics, chemical laboratory, drawing, designing and shop work.

For the junior year, mechanics and engineering, kinematics, drawing, machine design, materials of construction, physical and mechanical laboratory work, shop work.

For the fourth year a distinction is made between the electrical and mechanical courses. Those who wish to graduate as electrical engineers take physics, both lectures and laboratory work, which includes testing of instruments and determining of constants, the operation of dynamo machines and tests of same, photometry, efficiency tests of electric lamps, telegraph instruments, cables and a thesis which shall cover some practical and original work. Steam engineering, which includes lectures on steam boilers, steam engines, turbine water wheels, air compressors, hot air engines, etc., etc.; mechanical laboratory, with tests on steam engines, and application of Hirn's analysis; electrical engineering, which includes theory of the dynamo, etc., and shop work.

The preparation of the "artisan" for his work usually covers a fundamental public school training and in some cases a high school or even low grade polytechnic institute course, but the "artisan" usually enters upon his work when quite young, and by the time he reaches the age at which the "student" comes into competition with him, he has already made a good start in practical life and pretty thoroughly understands the operation of all machinery he is expected to handle. Most of his knowledge is picked up practically; that is, he learns from imitation, and though knowing "how" he does not always know "why." Some of these men endeavor to improve themselves, as far as their opportunity allows, by studying nights and attending some of the courses which are offered in cities for the instruction of just this class of men, but it takes a strong constitution and iron will to work faithfully during the day and study intelligently at night.

Prepared each in their own way, what are the conditions which the two classes of men above described may expect to meet when really ready for advancement along the line of their life work?

At present the electrical business is overstocked with men who are striving to make their mark in this profession. The cause of the overcrowding is due not only to the present de-

pression, which is affecting the electrical business, the same as all other mercantile interests, but more truly to the over-popularizing of this particular profession, and to the fact that the country needs but comparatively few electricians, in the full meaning of that term.

Though my statement that but few electricians are needed may at first sight be disputed, any one who will but consider the subject carefully will soon realize that such is the case, for there are, after all, but comparatively few electrical manufacturing companies in this country, and as their labor and their capital are invested in producing and not in discovery, their need is necessarily for business capability rather than inventive genius. Furthermore, those who are using electrical apparatus seldom have call for men that are highly trained theoretically, since most machinery is so manufactured as to need but little attention and such as may be given it by men who have had only practical experience.

In order to substantiate my statement as to the overcrowding of the electrical profession, I can say that at least one large manufacturing company in this country, during the present winter, has been receiving on an average thirty applications per week from high-grade college graduates who are desirous of entering their factory, although knowing before making application that they will be put at the coarsest and crudest work. The same company referred to has on file applications from perhaps 500 men who may fairly be classed as "artisans." Almost without exception, applications, whether from "students" or "artisans," are being refused, and in most prosperous times not over 20 or 30 per cent. of all "student" applications are accepted, while the "artisans" do not fare any better. The cause for this is found in the fact that unemployed "students" are so numerous that they can be had for the asking, and practically those of their number who can control some influence are more than sufficient to supply whatever demand manufacturing establishments may have for this class of men. Consequently, it must be recognized that the mere fact of having a thorough education cannot now insure one a salary of $10 per week in the electrical business, unless the "student" has some influence which must be powerful enough to secure him a start and assist him to rise.

For the "artisan" the prospects are not even as bright as for the "student." The former, in many cases, is already in some paying position by having worked up to it in securing his knowledge of the business, but if turned out of employment he will find at present almost no chance of securing a new position in the electrical manufactories, unless exceptionally capable or having some friend influential enough to make an opening for him. This is true despite the fact that when possible the large manufacturing establishments are desirous of employing those who have had a large amount of practical experience, even though little theoretical knowledge.

With such conditions existing, what are the prospects for the future?

There are yearly graduating from what may be called "classical schools," such as Amherst, Dartmouth, Brown, Wesleyan, University of New York, Union, Rochester, various State universities, etc., an indefinite though moderately large body of students who intend entering electrical engineering as a profession. In addition to these men there is another class in the technical schools who are studying special courses leading to the degree of electrical engineer. The latter class is being more fully prepared for its work than the former, and these are the students more likely to secure any available positions; and yet considering them alone, we find that they are so numerous as to more than meet any demand that is likely to arise for electrical engineers in the near future.

The following list, secured from the officers or catalogues of the institutions named, shows the number of regular students taking the course in electrical engineering for the college year 1893 and 1894 in some of our representative schools:

School.	Regular students.	Post graduates.
Mass. Institute of Technology..	(approx.) 240	(approx.) 22
Columbia	43	19
Cornell	322	41
Harvard-Lawrence Scientific School	56	..
Lehigh	141	..
Ohio State University.....	121	..
Princeton	22	..
University of Michigan.....	85	..
Worcester Polytechnic Institute.	(approx.) 80	6
Yale-Sheffield Scientific School..	65	..

Thus, in the colleges named—and the list could be greatly extended—we find 1,175 undergraduates and 89 post-graduates, making a total of 1,263.

We may safely assume that none of the above young men expect to be satisfied with salaries of $100 or $150 per month for the remainder of their lives, and yet it would seem from present indications that many of these cannot do much better than this.

To the personal knowledge of the writer, there are men who graduated in 1891 from colleges of the best standing who are at present working for $8 per week. These men are by no means incapable, but, lacking influence, have been unable to do much toward furthering their own interests. A graduate of four or five years' standing, that is, one who entered the field comparatively early, is getting $3,000 per year, another $2,400, and so on down. One student I know of who took both the graduate and undergraduate courses before leaving college in 1890, is said to be getting $15,000, but such cases are very exceptional, and only the result of combined ability, opportunity and financial backing.

The son of a stockholder of one of the leading manufacturing companies of the country,who had graduated from a technical school of high standing, worked for about $6 per week for eight months in the factory in which his father was interested, and then left, apparently discouraged at the outlook and the amount of drudgery that must be undergone.

It is a well-known fact that the General Electric Company is charging young men $100 who enter their courses in the factory; consequently the "student" not only receives small salary, but in addition pays for "tuition," so that it is becoming to be recognized, though perhaps a surprise to some, that "student" labor, viz.: labor performed by college graduates, can be procured for less than that of ordinary workmen.

The young man who starts in a factory as a "student" is likely to be set sweeping floors, wiping off machinery, oiling shafts, or, if fortunate, winding coils, assembling machines, testing apparatus, etc., the changes from one class of work to another being not rapid and advancement to higher positions depending on the ability and perseverance of the individual man.

Many young men may look forward to filling the position of consulting engineer; that is, one who shall design and superintend the installation of plants, but such men are not in very great demand, since purchasers who intend to make installations of any size prefer to deal directly with the manufacturing companies, who, on their part, keep a force of salesmen and roadmen, and are thus able to meet the purchasing companies more than half way, so that ordinarily the independent consulting engineer is not required. Doing a large amount of this work and thoroughly understanding its various branches, the manufacturing companies require comparatively few men of this class just referred to, so that, though there is some chance for young electricians in these lines, it is not all that might be expected.

If it were possible to learn the history of consulting engineers for the past five years, I think it would be found that

most of them would advise against any young man going into this line of the electrical business. At least one company that I know of, though successful in the first few years of its existence, has gradually been doing less and less business, despite the fact that it has an already established reputation as first-class engineers.

The idea of being an electrical inventor has a charm for many young men, which will enable them to overcome many obstacles and endure much for the sake of "perfecting their ideas," but only last summer I heard Edison say, in substance, that the patent business was a poor one; that it did not pay for the inventor to spend his time defending patents from infringement; the thing for the inventor to do was to proceed with the manufacture of his inventions, and, by their cheapness and acceptability, hold the market against all later producers, but this means that the inventor shall have excellent business ability, a quality which, unfortunately, seldom seems to be combined with inventive genius.

The lighting stations of large size generally have a good man in charge, but these positions are usually not such as would satisfy the class of men I have in mind, and because the growth of this business is not likely to be either sudden or rapid, the opportunities it offers cannot be considered particularly brilliant.

At present the electric street railways do not seem to appreciate the need for highly trained men, and most of them are satisfied with their horse railway superintendents, who have picked up enough electrical knowledge to make the road run, sometimes paying a dividend, but more often not. Of course there is no knowing what the future may develop in this line. It is possible that the railroads may substitute the electric motor for the steam locomotive. If so, here will be a demand for high-grade electrical engineers.

Recently power transmission has been attracting a great deal of attention, and where the newer and more intricate systems are used, first-class electricians are necessary for the successful operation of the plant, and possibly in this line more than in any other there are prospects for the young engineer.

In an article as brief as this must necessarily be, it is impracticable to adequately cover the subject, but possibly the line of thought herein contained may prove suggestive to the prospective electricians to whom it may chance to come.

Electrical Legislation in New York.

Electrical legislation is beginning to be of importance in the eyes of the lawmakers. Attracted by the greatness of the plan for the utilization of the power of Niagara, which they unwittingly sanctioned, legislators, either for themselves or for others, are coming to the front with bills that mean, although they do not always say so, the generation of electric power.

This session four such measures have appeared. What is known as "The Genesee River dam scheme" was introduced by Senator Parsons and Assemblyman O'Grady. Under the plea of restoring to the owners of water power the water diverted for canal purposes, it provided for a State appropriation of $250,000 to build a dam 130 feet high at Mt. Morris, near Rochester. It was shown in committee that a dam 85 feet high was all that was needed, and it was also pretty thoroughly revealed that at a cost to the State of millions of dollars the mill owners wanted to get this immense dam built to generate electric power. The bill was killed in the Assembly. It will probably be revived next year as a private enterprise.

Another scheme to get State aid to build a dam for power purposes on a similar plea is set forth in Assemblyman Hobbie's bill appropriating $200,000 for the construction of "reservoirs" in the Adirondack region in the vicinity of Carthage. No doubt the Champlain canal needs more water, but it is equally certain that the owners of water rights in Essex, Hamilton and Warren counties look upon the plan as one that will some day result in the furnishing of an enormous water power at their very doors. The bill is at present quietly sleeping in committee without any prospect of passing this session. It is estimated that the proposed "reservoirs" would cost about $1,500,000.

Still another plan is revealed by the bill introduced by Senator Pound and Assemblyman Clark, which seeks to incorporate the Niagara, Lockport and Ontario Power Company. It is not a new scheme by any means, but has been revived, as have most such schemes, by the vast possibilities that seem to cluster around the great hydraulic plant at the Falls. It has the merit of being willing to start without State aid, and the men back of the enterprise say the proposed $10,000,000 capital means business. The proposition is to take water from the Niagara River, near Tonawanda Creek. As yet the bill has made but little progress, and seems not likely to. It is said here that strenuous objections are being raised to allowing any more water to be taken from the Niagara River for power purposes.

Senator Donaldson's bill "To incorporate the Hudson River Transportation Company" has been widely discussed as another of these big electrical schemes, but even yet nobody is quite sure that the truth is known about it. With a capital capable of extension from $500,000 to $10,000,000, it incorporates comparatively unknown men with a blanket franchise to do anything from gridironing the State with wires, pipes or tunnels, to making, generating, supplying or storing gas, electricity, oil or water. This is asserted to be a scheme to pipe line water from up the State to the metropolis, but it is looked upon with so much suspicion that it will have to be very much modified, if it gets through at all.

With the purpose of establishing an electrical city at Waddington in St. Lawrence County, a bill has been introduced by Assemblyman Ainsworth that incorporates the St. Lawrence Electric Town Site Company. The capital is to be $3,000,000, and one of those interested is Major G. B. Burbank, who was prominently identified with the construction of the Niagara Falls undertaking. It is understood that a 12-foot fall of water can be had at Waddington, which will be so handled as to generate at the outset 25,000 h. p. Papermaking, woodworking and general milling purposes will in time require the generation of at least 75,000 h. p. in this venture, the projectors hope. The charter provides fully for carrying out these plans.

At the instance of the so-called "canal men" a bill has been introduced repealing the second section of the act giving the Superintendent of Public Works authority to make such contracts as that which has been entered into between the Cataract General Electric Company and the State. The object of the bill is to keep all electrical corporations off the canal grounds, but many think that with this contract in existence it will simply entrench the Cataract company in power and leave the superintendent unable to give any competitor a trial. This bill is likely to pass, but not to become a law.

Generally speaking, the raft of other electrical legislation before the Legislature relates to telephones, electric railways and electric lighting. There is also one bill by Assemblyman Butts, which provides for the licensing of all persons installing or operating electrical plants. The executive officers of all towns or cities are to appoint boards of three examiners, no examiner is to be an employee of any electrical concern, their findings are not to conflict with the rules of the New York fire underwriters, their pay is to be fixed by the city or town, no applicant must be of less than three years' experience, failure to obey the law is a misdemeanor, and no insurance company may take risks on

property on which the law has been violated, under penalty of a fine equal to its assessed value.

The street railway bills come chiefly from the Brooklyn members. Senator Bradley and Assemblyman Wray jointly have a measure which provides that "all exposed wires used in operating by electricity as a motive power by railroad corporations and others shall be properly and efficiently insulated." It is to go into effect on July 1—if it passes. Admitting that the intentions of this measure are of the best, there is a world of humor in it for an electrician. Senator Owens varies the bill by an additional provision that the companies shall all forfeit their charters unless they do the insulating within six months. In conjunction with Assemblyman Scanlon, he also wants an extra man stationed on the front platform of each car, so as to provide against accidents. Senator Donaldson has a bill that makes the consent of two-thirds of the property owners on any street a necessity before any work can be done in the way of stringing or laying wires.

Telephone legislation, which is an old story, takes the form of bills to reduce the rates. There are a half dozen of these, but most of them are so plainly for "speculative" purposes that they need no notice. The bill advocated by the New York Board of Trade and Transportation is an innovation, in that it provides a board of State officers to fix the rates, which, however, are not to be over $78 per year in cities of over a million inhabitants, $66 in cities of half a million or under, $48 in cities of a hundred thousand, $36 for twenty thousand population and $27 for less than eight thousand. No rate that provides a profit of more than 10 per cent. on the capital invested is to be allowed. This bill was practically killed by a statement that money was to be collected to defeat all those who voted against it. The others will never be heard from again this session. A measure also exists that allows the cable road to run wires through its conduits for the alleged purpose of signalling in cases of accident. Its passage is doubtful.

The several electric lighting bills chiefly empower electric railroads to go into the business of furnishing light or power in various places throughout the State, or empower village trustees to contract for the furnishing of such light. There is also one by Senator Owens, who does not want any company to charge over half a cent per hour for an incandescent light, nor more than 4 cents per hour for each arc light in any city of over 800,000 inhabitants. The fate of most of this legislation is uncertain, but the odds are decidedly against much of it getting out of committee.

Earth Forward and Return Circuit.

According to a daily contemporary, the Abbe Michel has succeeded in using two separate horizontal geological strata as a telephone circuit. The strata are conducting, and are separated by an intermediate stratum of comparatively insulating material. By coupling the transmitter to the surface stratum and a deep stratum, and similarly coupling the receiver, it was found that speaking could very well be carried on at a distance of 120 feet. Very rarely would the geological conditions permit of this arrangement being adopted; while in any case, of course, it would be impossible to have more than one system in the same locality.—London "Electrician."

Underground Wires in Philadelphia.

From the message of the mayor of Philadelphia it appears that 300 miles of underground telephone, telegraph and electric light wires have been added, that Broad street is relieved of overhead wires, and that they are being removed from Market street. The city now has 680 miles of underground wires in successful operation.

Nikola Tesla and His Work.

BY LIEUT. F. JARVIS PATTEN.

Mr. Nikola Tesla has been prominent in the electrical field for more than ten years, and the creations that have sprung from his brain have made his name familiar to the general public. His work, however, has been of such an advanced order of electrical application that comparatively few have a clear idea as to just what he has accomplished.

Within the past three months a book has been published which tells the story and which is indeed a rather exceptional contribution to the electrical literature of the day, presenting, as it does, an elaborate description of all that Mr. Tesla has thus far given to the public in his patents and lectures.* It includes not only descriptions of his numerous inventions, but his personal writings upon the lines of thought and experiment he has advanced, and so affords the opportunity for a brief review of what he has done.

From both a literary and typographical standpoint the book is an excellent addition to the electrical library. It is tastily gotten up, and evinces care and literary skill in the editing; the illustrations, which are profuse, are good, and this is equally true of the frontispiece portrait of Mr. Tesla, which to many will largely enhance the value of the book.

With the exception of a short biographical sketch, Part I., comprising twenty-four chapters, is devoted to a rather exhaustive treatment of the many forms of rotary field motors that Mr. Tesla has from time to time invented. One of these chapters, which will meet the requirement of the average reader, is an abridgment of Mr. Tesla's well remembered lecture before the American Institute of Electrical Engineers in May, 1888, in which he gave for the first time the rotary field motor invention to the public. Most of the remaining chapters of part I. are detailed descriptions of different modifications of the general multiphased motor system, such as would likely occur to an active inventor anxious to bar with a profusion of patents every access to a broad system naturally open to many variations. In fact, many of these chapters are little else than mere transcripts from patent specifications.

Part II. is devoted to high frequency phenomena, a field of investigation that seems to be peculiarly Mr. Tesla's own. It opens with an interesting chapter that seems to be from the editor's pen, in which he gives his own resume and estimate of the matter set forth in Mr. Tesla's three lectures upon high frequency effects, lectures given in succession before the American Institute of Electrical Engineers, the Royal Institution in London, and the Franklin Institute in Philadelphia. These three lectures, reproduced verbatim and making as many long chapters, constitute, in fact, the main part of the work.

Part III., comprising seven short chapters, describes quite a variety of inventions of relatively minor importance, so far as Mr. Tesla's work is generally known, and which would probably never have seen publication beyond the patent specifications, from which they are evidently drawn, had not the exhaustive design of this book rendered their inclusion excusable. The inventions here mentioned include an arc lighting system of earlier days, some suggestions of how a unipolar machine might be built, a pyromagnetic generator, a thermomagnetic motor, an anti-sparking dynamo brush, and a method of regulation for constant current. These chapters are interesting mainly as showing how much a professed inventor must do that is not in the line of great achievement.

A short but interesting chapter describing Mr. Tesla's personal exhibit of apparatus at the World's Fair, and a brief reference to his latest surprise, the "electro-magnetic

*"Inventions, Researches and Writings of Nikola Tesla." Edited by Thomas Commerford Martin. New York. 1894. Price, $4.00.

oscillator" for producing high frequency currents by mechanical means, ends the volume.

With the exception of a few chapters by the editor, the volume is a collection of Mr. Tesla's writings, and those who have followed his work closely will find in it little that is new. Much of the subject matter in Part I., devoted to polyphased currents, is taken in a sweeping manner from patent specifications, and as such will be new to some who little know, without such a review, how thoroughly Mr. Tesla looked after the possible variations of his broad invention. The various motors described are shown in their most elementary forms by mere diagrams of the operative circuits.

While these numerous variations of the same general idea are instructive as showing the growth of the invention in the inventor's mind, and the gradual development of the mere abstract idea to different practical forms, still, in all these descriptions there is little to be found that has any practical bearing or importance to-day. The engineer will find in these chapters little that he cares to remember for practical use or application, the advocate of controversy as to priority of invention will find ample data for reference, and the student of electrical science will find in them evidence of how little the most thoughtful inventor can foresee the features of his invention that will lead to most controversy and discussion, for nowhere in these earlier writings is any importance attached to the frequency of the alternating current used. Throughout the twenty-four chapters of Part I. the charming delusion prevails by inference that all these machines are as good at one frequency as at another. One might also draw the erroneous conclusion that polyphased currents were first discovered and used by Mr. Tesla; on the other hand, no one can doubt that the biphased and triphased rotary field machines were simultaneously worked out by him as early as 1887. He did not leave the triphased machine for a follower to invent.

Following the general treatment of multiphased machines come descriptions of various devices and makeshifts (no word seems more appropriate) for working these machines by a single alternating current. The rotary field motor operated by multiphased currents, as its every feature indicates it should be, is a unique and characteristic thing and should have been left to the field of operation that its inherent simplicity must sooner or later create for it. Its birth, however, was contemporaneous with that of single alternating current working, so the genius that first showed the rotary field machine in practice must pervert his invention to meet the requirements of a system to which it was entirely unsuited. The description of these many attempts adds but little to the value of the book.

In chapter XIV. is given a description of a single alternating current motor that does not depend upon the production of two currents from one, and another chapter shows a similar motor with a condenser in circuit, which points to Mr. Tesla as one of the earliest users of this device.

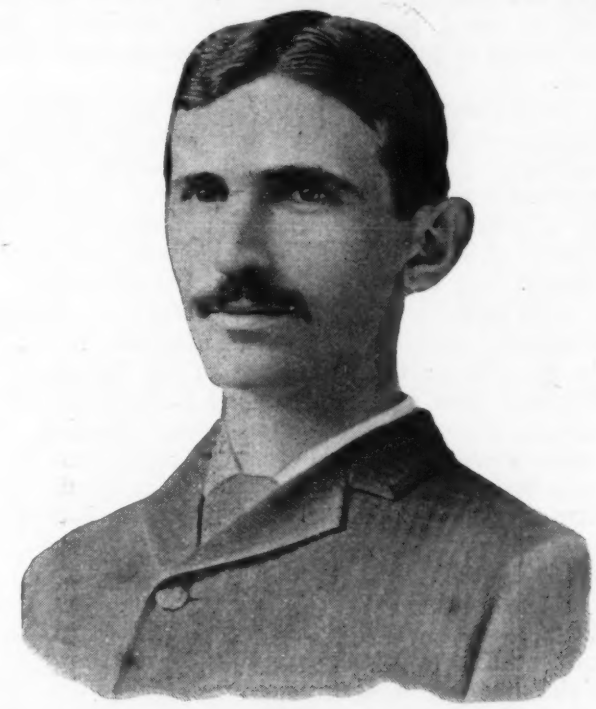
One cannot resist the conclusion, however, that this part of the work is a little padded with the only ostensible purpose of showing what a lot of inventions Mr. Tesla has made, and the reader is tempted to wish he had not invented so much.

In Part II., devoted to high frequency effects, we have to consider an entirely different order of work, which may be properly classed as pure science, for there is scarcely a practical effect described in the many pages given to the three lectures.

In this work the purpose in view has apparently been to establish by experimental process the identical character of light and some form of electrical manifestation of energy. In attempting this proof, Mr. Tesla has doubtless given new evidence in favor of the electro-magnetic theory of light, which theory, of course, preceded his work.

In his endeavor to obtain a very high frequency, Mr. Tesla doubtless started with the notion of setting matter into vibration at a rate approximating that of light, with the expectation that under such violent molecular agitation it would emit light. It is left to be inferred that so high a frequency is scarcely possible of attainment, while a much lower one under favorable conditions produces the desired effects. The investigation of these conditions constitutes a large part of the three lectures, which are sometimes tedious with exhaustive detail; though doubtless essential to a thorough investigation of the problem and invaluable as a guide to further work, these minutiae are not always interesting reading. This fact seems to be appreciated occasionally, and when it is we find a digression in the form of some purely speculative possibility—generally a suggested practical application of the effect under consideration. These are often so purely speculative in character as to be actually amusing.

Seriously speaking, the scientific world to-day believes in



NIKOLA TESLA.

the electro-magnetic theory of light which grows out of fundamental views enunciated by Faraday and elaborated in later years chiefly by Maxwell and Hertz. Mr. Tesla has not touched the mathematical side of this question, and so has added nothing to Maxwell's proof. Hertz established by experimental or physical demonstration the truth of Maxwell's deductions. So, if Mr. Tesla has added something to our scientific knowledge of this subject, it will consist in what he has added to the work of Hertz.

Broadly speaking, however, the Tesla experiments are the same in general results as those performed by Hertz, but are undertaken in a different and entirely original manner and are shown in far greater profusion and variety of effect. Indeed, Tesla's investigation of the electrostatic field, so far as variety of effect is concerned, would seem to leave but little to be desired. Tesla's labor in this direction was simply a long and painstaking investigation, the apparent purpose of which was really to determine what practical use, if any, can electrical science derive from the so-called Hertzian oscillations. If this question must be definitely answered by the Tesla experiments, we are compelled to say that no practical use for such phenomena has yet been shown.

The vacuum tube and light effects produced by rapid al-

ternations of an electro-magnetic or electrostatic field, and the transmission of energy along a single wire without a return lead, are beautiful, and mostly novel exhibitions of what can be done with electric energy under properly arranged conditions, but they are not of practical value in any use that has yet been made of them. They are simply advanced laboratory experiments of great scientific beauty and interest.

The introductory part of one lecture is given to a description of the apparatus used for producing the high frequency effects, and the precautions that must be taken in the arrangement of the parts are carefully pointed out with a view to help the experimenter who desires to follow this line of investigation.

Another is opened with a description of the best form of generator to be used, preference being given to a form of motor dynamo for transforming direct current into an alternating current of low voltage by a simple dynamo conversion. This low voltage alternating current is then changed to high tension by an ordinary converter, and this current, on being passed through the oscillatory transformer, has its frequency raised to something like a million a second.

Introducing another lecture, Mr. Tesla goes into a long digression upon the human eye that deals in nothing but generalities, having little or no bearing upon the subject.

The effects described in these three papers may be classed, for sake of arrangement, as phenomena produced by electrostatic force, dynamic electricity phenomena, and vacuum tube effects. We will consider some of these briefly.

Mr. Tesla claims that all electric and magnetic effects can be traced to the action of electrostatic molecular forces. In fact, he goes much further in one of his speculative digressions and refers everything among Nature's fanciful designs to the action of electrostatic force. His first claim finds some confirmation in a beautiful experiment he describes, in which he produces a veritable flame by the action of electrostatically charged molecules. A flame is thus produced by which, however, no material is consumed. He thinks this experiment gives us a further insight into the nature of an ordinary flame, which he attributes to the electrostatic effects produced by the chemical changes going on.

The experiments in which vacuum tubes are shown glowing brightly by simply being placed in a rapidly alternating electrostatic field are beautiful, but the practical application suggested—of lighting an apartment by simply creating an electrostatic field in the space between the walls and using detached vacuum tubes for lamps that will always be aglow when between the walls—is far from realization, and the reading public should not be left with the impression that anything of the sort has ever been accomplished.

Another very interesting experiment consists in the operation of lamps and motor devices by the discharge from condensers, and he points out methods of transforming or changing the voltage of direct as well as alternating currents by means of condensers, and expresses the hope in this connection of perfecting apparatus by which electricity of high tension may be obtained directly from heat energy itself. No suggestion is, however, given as to what the method is or how the transformation is to be effected. This hazy suggestiveness of great practical ends just in view but never reached becomes at times somewhat unsatisfactory.

Among the most beautiful of this array of experiments is one that illustrates the impedance of a rod or bar of practically no resistance when connected in a circuit to which a very high electromotive force and frequency is applied. Owing to the impedance the current may be shunted around it through a circuit of comparatively high resistance supplied with incandescent lamps that glow brilliantly when their terminals are connected to the bar at points only a few inches apart. It is further shown in this experiment that there are points or nodes on the bar, from which no current can be taken in the manner described, while others differently situated give a high difference of potential, and so marked is this distribution that the points can be readily selected by an ordinary voltmeter or by the lamp circuit itself.

The most surprising of the new facts elicited from these investigations is that the shock due to these very high potential and high frequency discharges can be supported by the person without serious inconvenience. This Mr. Tesla attributes to the fact that the body offers a large cross-section to the high frequency current, which distributes itself uniformly, so that the current density is small at any point of the path. The inference also follows that these currents pass through the human body in much the same manner as a direct current passes through a good conductor. The E. M. F. used in this experiment was about 2×10^5 volts and the frequency near a million a second. With this enormous potential literally in hand Tesla grasps one pole of the high tension transformer and approaches the other to the opposite pole, on nearing which a brush discharge having the appearance of a flame passes from his hand to the free pole. Enlarging upon this phenomenon in his usual style he estimates that with a frequency of four million and an E. M. F. of 3×10^6, his entire person would be enveloped in such a flame, but without danger.

In another beautiful experiment two straight wires are connected to the poles of the high tension transformer and stretched parallel to each other across the room, there being no cross connection between of any kind. When given the high tension current, these wires emit streams of light or brush discharges so profusely that light enough is produced to distinguish objects in the room. If these wires are bent into concentric circles, one inside the other in the same plane, the annular space between them is filled with streamers that make a sheet of light about a metre in area.

Perhaps the most interesting feature of these high frequency phenomena is their apparent capability of operating various sorts of electric devices—even motors of a certain description—and this with only a single wire leading to the source of energy. In one of these illustrations Mr. Tesla is led to say that he thinks it probable these experiments indicate the possibility of operating a motor at any point of the earth's surface from a central source with only an earth connection to the latter. This he hopes to accomplish by causing the electrical charge of the earth to oscillate and by the use of resonance a distant motor is made capable of picking out the current of different rate or frequency that is intended for its consumption or supply. It is probably suggestions of this character that have caused some readers to view Mr. Tesla's work as that of a visionary enthusiast.

It is more important, however, to determine just what Tesla has given in this discussion of high frequency phenomena that is of value—for its value is really quite independent of any views he may hold concerning the possible future applications of electricity.

He has built up a method of experimental investigation of physical phenomena, concerning which much remains to be learned. This method, with its vast array of beautiful experiment, is original and goes some steps beyond the point reached by previous work in this field, which may be defined as the experimental investigation of molecular physics. In all this there is little of practical interest to the electrical engineer. In going into this domain Mr. Tesla left what is commonly called electrical engineering behind and his work in this new field should therefore not be judged by its standards.

To the physicist Mr. Tesla stands a pioneer of a new and wide field of research.

To the electrical engineer he stands the inventor of the

rotary field machine, a brilliant and unique conception, which he soon left for the engineer to elaborate and figure out.

Before the general public he stands a phenomenal inventor from the Eastern World, from whom is expected little less than if he carried Aladdin's lamp in his hand, which, of course, is wrong, and an injustice both to the public and to Mr. Tesla.

Mr. Tesla is a hard and patient worker and has done enough for one decade in producing the rotary motor. He has doubtless much of importance in store for us, but the difference should never be lost sight of between the search for Nature's truths in the laboratory of the physicist and the reduction of the results attained, however great their promise, to a form suitable for commercial use.

The Home of the Card Motor and Dynamo Company.

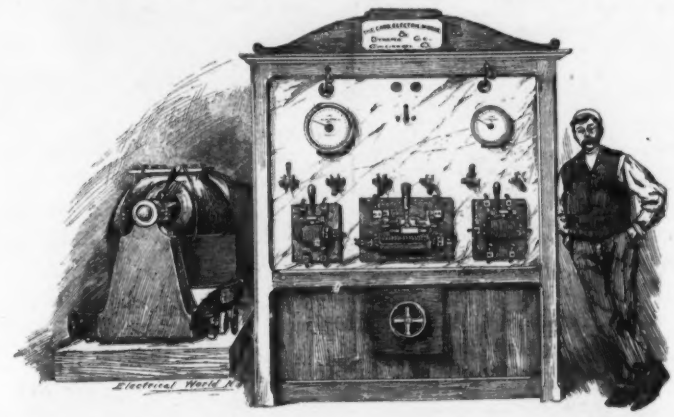
THE South and Southwest have long been recognized as among the important fields for the introduction of electric installations of all kinds, and the city of Cincinnati in particular is considered the central point of a vast territory; in fact, it is one of the leading cities of the country, electrically speaking. The success of the Card Motor and Dynamo Company, pre-eminently a Cincinnati enterprise, is but natural, therefore.

Some four years ago this company was started. Step by step it has steadily grown both in the extent of its plant and scope of its work. From a small shop on one of the unimportant streets of the city, it has become what is in many respects one of the most interesting factories yet constructed.

The factory fronts on Broadway, and extends down Hunt street a long distance. Practically all the lower floor is devoted to the factory. The Broadway front of this floor is used as a show room, where motors and dynamos of all types and sizes manufactured by the company are on exhibition. The offices, located immediately over the show room, are commodious and attractive. The rest of this floor is devoted to a store room for material and supplies of all kinds.

It is on the first floor, where the Card machines are built, however, that the visitor finds most of interest. The entire power is supplied by a Card generator, situated alongside of the handsome marble switchboard shown in the cut. A steam engine runs this one generator, from which light for the entire building and power for all the machines are obtained. The plant is so arranged that whenever it is necessary to work overtime the electric current is obtained from the central station, thereby saving the cost of running the steam plant.

All of the machinery on the floor is operated by Card

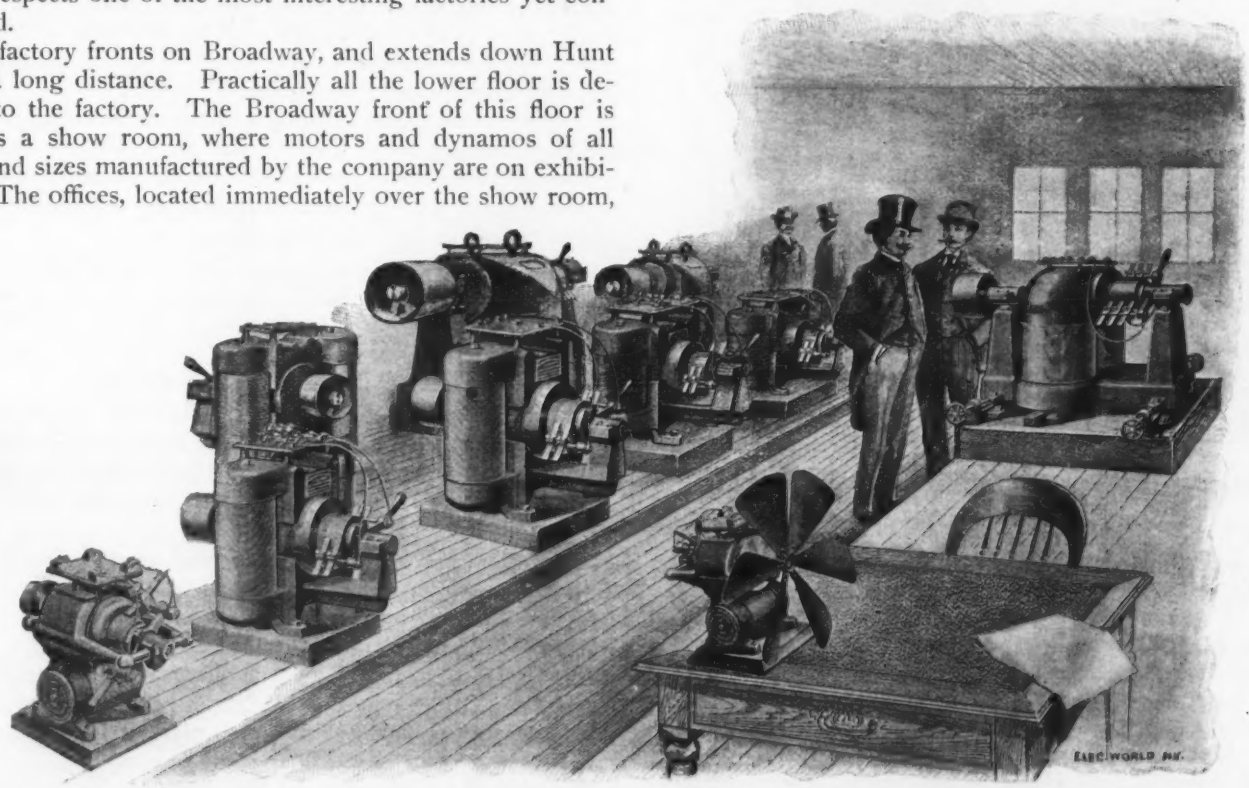


SWITCHBOARD AND GENERATOR IN THE CARD FACTORY.

motor, either directly connected or belted to the machine. The accompanying illustration shows one of the large planers operated by a 3-h. p. motor suspended from the ceiling. With this arrangement any desired speed can be secured for the machine. It is at present run at two speeds, a slow forward movement and a quick return, an automatic controller serving to change the speed of the motor. This obviates the necessity of any extra shafting or gears to secure the same result, and almost doubles the capacity of the machine.

In another sketch is shown a drill press directly connected to a Card motor. Connected in this way, it will readily be seen what an advantage is secured by having a reversing power. The machine can be adjusted for any work obtainable from such tools, with the increased advantage of a variable and reversible speed.

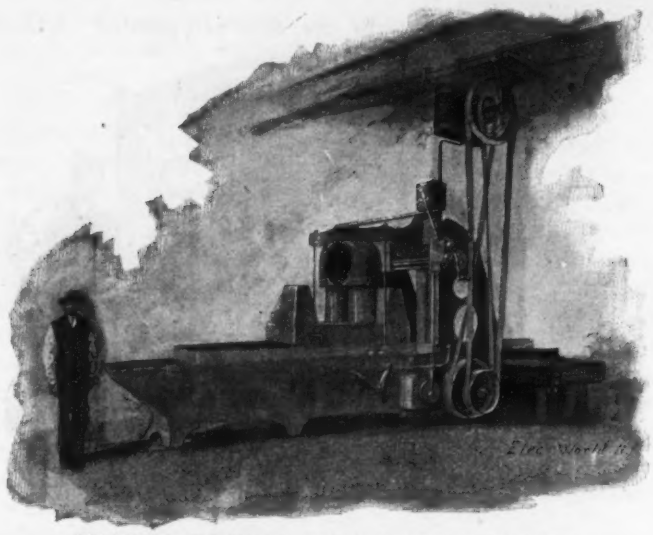
The lathes, and there are many of them, are all operated with motors of the Card type, so that it may be said that



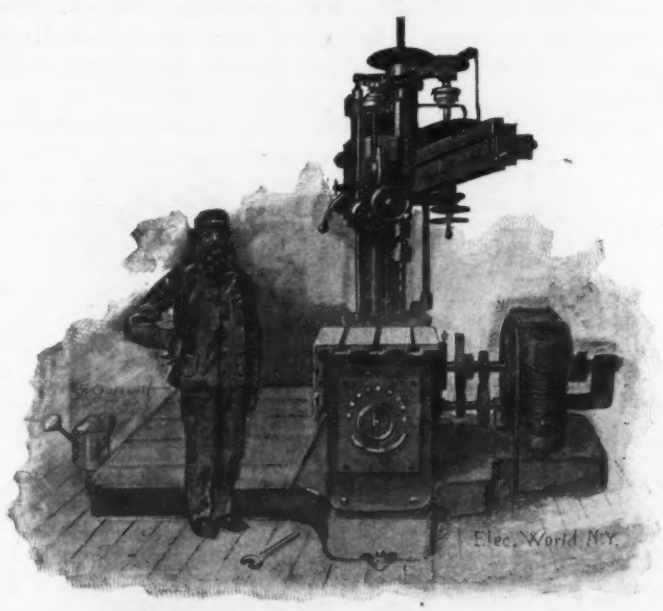
SHOW ROOM IN THE CARD FACTORY.

Card motors and dynamos are manufactured by themselves.

The Card Motor and Dynamo Company now manufactures motors and dynamos of all sizes, paying particular attention to the operation of machinery with motors. From its own experience, it claims to show a saving of 35 per cent. in the cost of operation, and that the performance of a machine so constructed is highly satisfactory in every sense.



PLANER DRIVEN BY ELECTRIC MOTOR.



ELECTRICALLY OPERATED DRILL PRESS.

Recently the company has taken up the manufacture of street railway apparatus, and it anticipates an extensive business in this line.

Electric Light Prospects in Messina.*

BY CHARLES M. CAUGHY.

The present contract for illuminating this city by gas expired on the 28th of March, but owing to a deadlock in the municipal council, the Ministry appointed a commissary, who will act until the organization of a new body in June, and no action will be taken until then.

The only illuminating plant in Messina is the gas works, absolutely owned and operated by an English company, under a concession from Victor Emmanuel in 1861, and which has been once renewed. The light furnished and the prices charged are both causes of great dissatisfaction.

The power is only eight candles, and it costs about $1.92 gold for 1,000 cubic feet. It appears to me that there is here a great opportunity for any enterprising electric light company, for in Italy, as well as in the United States, the people are only too willing to adopt the latest and best illuminant.

For the installation of a plant for lighting stores and dwellings and the furnishing of motive power the prospects are equally favorable. The "locus habitandi" in Messina, as in the majority of other European cities, is the apartment, or what we know as the "flat." The walls here are never less than two, sometimes three, feet thick, and built of stone, so that the introduction of gaspipes on any floor except the first, where the connection is made from the street, is attended with so much labor and expense that very few houses except those recently built, into which it was carried during construction, are so equipped.

No local obstacles confront the introduction through the smallest of apertures, under window frames, etc., of the tiny electric wire, which can be carried, upon arms projecting from the houses, that privilege being now enjoyed by the telephone company, so that one of the largest factors in construction expense, the buying and planting of poles, is avoided.

As to motive power, there is one applicant already in the field willing to adopt it as soon as it is installed, and that is the Tramway Company, which runs its lines from Messina to Faro Point, a distance of 9 miles, and to Barcelona, a distance of 30 miles. It is now operated by dummy engines.

I realize that the first questions that will arise are, what will be the cost of constructing a plant, and what will coal cost?

When I say that the average price for unskilled labor is 35 cents and skilled 45 cents per diem, that the laying of stone, including cost of material, is 50 per cent. cheaper than brick; that lumber is no more expensive than in the United States; that land is remarkably cheap, and that Cardiff coal costs, delivered on the wharf, $4 per ton, I think the questions are satisfactorily answered.

Before writing this report, I made a thorough canvass of the business men of the city, and they, without exception, promised their most earnest co-operation, both with their influence and their purses, to make the installation of an electric plant in Messina a success.

With the day of deliverance from the thraldom of a gigantic monopoly at hand, the advent of any Moses will be hailed with joy, but if he come from the West, with which the commercial interests of the Messinese are so closely allied, he will receive the heartiest of welcomes.

Let me say to those companies who may see fit to enter into competition to do so in propria persona, so to speak, by sending a well equipped representative to look over the grounds, and to be on hand to meet any emergency, or to answer any question that may arise.

To enter into correspondence and overwhelm those in authority with circulars, indorsements, etc., printed in a language that to most of them is unintelligible, is a sheer waste of printer's ink, stationery and stamps.

The fastest steamers of the Hamburg American line leave New York every two weeks, and land their passengers in Naples in ten days, from which place it is only a night's sail to Messina.

A personal representation will, I am sure, be productive of good results, while correspondence will only tend to fill the waste basket.

I do not wish for one moment to be understood as saying that the installation will be an over easy task to accomplish, for this gas company is in no wise different from like corporations in the United States, and no doubt will make a bitter fight, but in this case the intruder will find helping hands awaiting him from a long oppressed people, who will only too gladly array themselves on the side of progress.

*Advance copy of Report of U. S. Consul at Messina.

THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM THE PRINCIPAL FOREIGN ELECTRICAL JOURNALS. BY CARL HERING.

NOTE.—*Owing to the crowded condition of this department the following changes will be made, the object being to enable more space and attention to be given to abstracts of articles and papers of a more important nature. Almost every issue of each of the foreign journals contains descriptions and data, often with illustrations and tables, of local central stations and isolated plants; unless they appear to be of special interest they will not be noticed hereafter. References to descriptions of steam and gas engines, boilers, fuels, etc., and all other subjects not belonging under the heading of electricity and magnetism, will in general be omitted. The Swiss monthly "Journal Telegraphique" (in the French language) contains probably the best telegraph and telephone statistics of the world, and as this Journal is doubtless accessible to those specially interested in this subject, references to such statistics and descriptions in that Journal will hereafter be omitted. Serials in the nature of a treatise on a subject will be noticed only once; this will apply also to papers which are continued in several issues and which are merely referred to in these columns as distinguished from being abstracted. When the same paper or article is reprinted or abstracted in several journals, only the first appearance will be noticed, except if the original is in a foreign language and the reprint is an English translation, in which case the references to the translation will also be given, as usual. Very good abstracts, generally longer than can be given here, are published in the monthly journal of the Institution of Electrical Engineers (London), and in the Proceedings of the Institution of Civil Engineers (London), which abstracts will be noticed only in case the original article has not been mentioned in these columns.—C. H.*

ELECTRO-PHYSICS.

Cathode Rays.—The Lond. "Elec.," March 23, contains an article by Prof. Fitzgerald, in which he reviews briefly a recent paper by Mr. Lenard in "Wied. Ann.," No. 2, 1894, on "Cathode Rays in Gases Under Atmospheric Pressure and in Extreme Vacua"; it is followed by a translation of the complete paper, together with a number of illustrations. The subject of the investigation is the action that takes place in the so-called dark space surrounding the negative pole in a Geissler tube; these rays are capable of penetrating thin metallic partitions; in Mr. Lenard's apparatus he seals a small hole or window in a vacuum tube with a thin piece of aluminium foil, through which the cathode rays are passed normally, producing a faint glow outside of the window visible to a distance of 5 centimetres; substances which become phosphorescent in ordinary vacuum tubes glow brightly in the air to distances up to 8 centimetres from the window; he concludes that cathode rays are a phenomenon in the ether and are independent of the presence of matter; the paper is of considerable interest, and does not admit of being abstracted.

Electric Transference of Heat.—In an editorial in the Lond. "Elec. Rev.," March 23, attention is called to the fact that the difference of potential between a conducting body and iron depends on whether the latter is magnetic or non-magnetic, and calls attention to a recent Academy paper by Mr. Houllevigne, in which he examines this phenomenon; the paper is briefly described, but the explanation is not quite clear; it appears that a magnet placed in the neighborhood of one of the junctions of a copper iron couple modifies the difference of potential; as no current can be produced, there being no energy consumed, the variation of the E. M. F. must be compensated in the rest of the circuit, which compensation occurs in the magnetic parts and is assumed to be in the nature of a continuous variation of the potential between the sections which are unequally magnetized, a conclusion which has been tested experimentally in that paper.

Compensating Electromotive Forces.—An Academy paper by Mr. Schuerr on "Means for Compensating the Electromotive Forces of a Cell," is abstracted in "L'Elec.," March 17; the object is to find if it is possible, with the aid of other local couples, to compensate for the various E. M. Fs. of a cell.

Capacity of Leyden Jars in Series.—The Lond. "Elec. Rev.," March 23, explains the apparent disagreement between several writers.

Condenser.—A theoretical discussion from the Italian by Mr. Lori of a condenser made of cylinders which are not coaxial, is given in "La Lum. Elec.," March 24.

MAGNETISM.

Magnetization of Soft Iron.—A translation of Mr. Joubin's paper, mentioned in the Digest Feb. 24, is published in the "Phil. Mag." for March.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Testing Iron of Transformers.—In an article by Mr. Feldmann, in the Lond. "Elec.," March 23, he gives the following formulas for the eddy current loss per cubic centimetre, as determined from Fleming's values:

$$\left(\frac{b\,p\,\mathfrak{B}}{2.5\times 10^6}\right)^2 \text{ watts for sheets,}$$

$$\left(\frac{b\,p\,\mathfrak{B}}{4\times 10^6}\right)^2 \text{ watts for wires,}$$

in which b is the thickness or diameter in millimetres, p the frequency, and $\mathfrak{B}$ the maximum induction. These he verifies experimentally by calculations from different sets of tests, giving the results in a number of tables; he believes the method to be one for workshop use; he thus shows good reason for believing that the formulas at present in use agree with results of observation. Editorially a source of error not alluded to in this paper is pointed out—it is questioned whether it can safely be assumed that the reading of a Cardew voltmeter is a measure of the maximum voltage; in the above case this appears to have been so, but it is recommended not to assume this in every case without some experimental determinations of the shape of the wave.

Testing Iron.—A correspondent in the Lond. "Elec.," March 23, asks how Mr. Parsons in his method, explained in the Digest last week, obtains equal induction in the two samples; as he explained it, a core of laminated brass would appear to be excellent material for a transformer.

Brilliance of a Candle Flame.—According to a paper by Mr. Glan, from "Wied. Ann.," mentioned in the Lond. "Elec.," March 23, the luminosity of a candle can be calculated directly from its flame; he found that the height of the flame was not the only factor determining the brightness; also that a stearine candle 5.88 centimetres in circumference had a higher luminosity (candle power?) than another 6.49 centimetres in circumference; he found that the ratio of the volume of the flame to the illuminating power was very nearly constant, the difference between the calculated and the observed results being never greater than 3 per cent.; from this it follows that equal volumes of the bright flame of any two candles give out the same light; editorially, it is stated that the mean projected area of the luminous part of a standard candle flame is about half a

square inch and the brilliancy is therefore 2 candle power per square inch.

Voltameter.—The "Elek. Zeit.," March 22, gives a short illustrated description of an improved gas voltameter intended for currents up to 0.2 ampere; the hydrogen alone is measured, as the absorption of the oxygen by the liquid introduces errors; the accuracy is said to be very great, the difference between the measurements made by it and by the silver voltameter being only 0.05 per cent.

Recording Voltmeter.—A translation of the description of the Raps instrument, mentioned in the Digest Jan. 27, is given in abstract in the Lond. "Elec.," March 23, including four of the most important illustrations.

Influence Machines.—The two forms of the improved machines of Mr. Bonetti are illustrated and described in "L'Elec." March 17; it will be remembered that there are no sectors in these machines and that the number of brushes is increased, by which modifications the output of the machine is considerably increased, but it is no longer self-exciting. The "Bul. de la Soc. Int." for February contains a description of this machine by Dr. d'Arsonval, but without an illustration.

Simple Thomson Galvanometer.—A very simple form is described and illustrated in the "Elek. Zeit.," March 8, which may be used with the reflected beam or telescope.

DYNAMOS AND MOTORS.

Electric Motor in Aeronautics.—In an editorial in the Lond. "Elec. Rev.," March 23, belief is expressed that electricity offers the most promising prospects of immediate results, the electric motor being the easiest of all to develop the required degree of lightness and power; attempts to provide steam or explosive motors will prove costly if not futile; "a minimum of 10 pounds weight per horse power, and at most 15 pounds, has been calculated as necessary" (whether this means that 10 to 15 pounds is the maximum or greatest weight which a motor and source of power may have per horse power hour is not quite clear); reference is made to obtaining the current from a sort of trolley wire, a device mentioned in the Digest some time ago; Trouve has succeeded in developing energy in a small motor at the rate of 1 h. p. for each 7 pounds (but it does not state the total weight or total horse power); neither gas nor steam motors have done any better.

Alternator.—It is explained in the Lond. "Elec.," March 23, that the ring in the alternator, described in the Digest March 31, is not a solid casting of steel, as was stated in that article, but that it is built up of sheet iron; in a test of a 275 kw. alternator the loss was 6,000 watts for hysteresis and Foucault currents.

ARC AND INCANDESCENT LIGHTS.

Theory of Electrical Projectors.—The articles by Mr. Blondel, abstracted in the Digest Dec. 3, 1893, and Jan. 6, 1894, have been published by Lahure, of Paris, in a more extended form as a pamphlet; a long list of articles and works on this subject is given in an appendix.

TRANSMISSION OF POWER.

Series Transmission of Power.—In the "Elek Zeit.," March 8, Mr. Schultz, after mentioning the advantages of series traction, among which are the greater torque and the fixed positions of the brushes, describes several small installations in Germany, which have been in operation for some time; in all of these there is but one generator and one motor; it seems that telegraphic communication is necessary for signaling from the motor to the generator; for starting the motor, the motor and generator are connected in circuit, and the generator is then started; notwithstanding considerable loss in the line there is practically no variation in speed for very great differences of load; with a 50-volt loss on a 600-volt circuit, the efficiency with a 24-h. p. installation is 75 per cent. In another the motor is at a pumping station 1,000 feet distant, and is operated entirely from the generator end, there being no attendant at the motor; in another case the series motor is at times coupled in parallel with a steam engine, a combination which is said to work very satisfactorily; a further advantage of the series machines is that the neutral zone of the armature does not shift with varying loads.

ELECTRIC RAILWAYS.

Board of Trade Regulations.—The London journals of March 23 publish the regulations which the Board of Trade has decided to prescribe regarding tramways worked by electricity; the proposed regulations were published some time ago, the present form being the final modification. The Lond. "Elec." and the Lond. "Elec. Eng." also publish the proposed regulations for the electric underground railways in metal lined tunnels. Both of these sets of regulations are too long to be given here and are not of a nature to admit of being abstracted. Editorially, the Lond. "Elec." states that in scarcely a single instance can the interests of electric traction be said to have suffered by the amendments made to the proposed rules; the general effect of the regulations is to compel the use of feeders; the maximum earth current is increased from 2 amperes to 10 per line, and a current equal to 5 per cent. of the total output of the station is permitted as an alternative; one main purpose of the regulation is to insure that if any leakage passes through the earth it shall enter gas and water pipes and not leave them, except through proper metallic conductors, thus avoiding corrosion; an important concession is the allowance of 15 per cent. increase in the fall of potential in regulation instead of 5 volts. The rules are also discussed editorially in the Lond. "Elec. Eng.," where the opinion is expressed that electric traction interests have no ground for objecting to the rules as they now stand.

High Speed Railway.—A recent paper by Prof. Zipernowsky on the proposed Vienna-Budapest line is abstracted briefly in the "Elek. Zeit.," March 8. He claims that speeds of 120 to 150 miles per hour are practicable, but limits himself to a speed of 72 miles, the total distance being 167 miles; with a single track and a single passing point at the middle of the route, a train can be dispatched in each direction every one and a half hours; with three such passing places, the number of trains is doubled; with four motor cars running continuously 1,000 h. p. will be required, produced by two stations of 300 h. p. each; for the transmission he suggests 10,000 volts, which are transformed at 50 stations to the 500-volt line current. The present scheme is a modification of the one described in The Electrical World Oct. 10, 1891, and appears to be a more possible one.

The article mentioned in the Digest Feb. 24 is contained more at length in the "Bul. de la Soc. Int." for February.

Waterloo and City Railway.—According to the Lond. "Elec. Eng.," March 23, the construction of this railway is about to be begun; it will be about a mile and a half long, connecting the Waterloo station with a point in the eastern centre of London; the description is confined entirely to the civil engineering features; it will be somewhat like the City and South London underground railway, an important difference being that the tunnels will be 12 feet in diameter in place of 10; each car will carry 50 passengers, and each train will be composed of seven cars; where it crosses under the river it will be 60 feet below high water; one terminal will be 63 feet deep and the other 55 feet; it is estimated to cost two and a half million dollars.

Conductor Rail System.—According to the Lond. "Elec.," March 23, a line will be run in Lyons connecting the centre of the town with the Exhibition, in which a conductor rail is used, connected in circuit by magnets laid underground;

the system is that of Claret & Vulleumier, and is said to have been used successfully at Clermont; no further information is given.

Electric Tricycle.—The Carli vehicle is illustrated and described in "La Nature," March 10; it contains a battery of 10 cells, each of a capacity of 100 ampere hours, making a total of two kilowatt hours; a cell weighs 11 pounds, contains 5 horizontal plates and can be discharged at 5 amperes; the total weight is 352 pounds; the motor takes 550 watts; it can therefore run for four or five hours and can also be used to recharge the accumulators; he charges the accumulators with very small currents during a long time, which enables him to use primary batteries; for starting or for a sudden demand for power, there are a set of rubber springs, which can be stretched by hand or during a run, and which are applied by means of a catch; their force is sufficient for running about 150 feet.

Electric Omnibus.—"Ind. and Iron," March 16, contains an illustrated description, the illustrations of which, however, show only the exterior, of the omnibuses which are to be run in London by means of storage batteries; little data are given.

Cars Driven by Gas.—The Lond. "Elec.," March 23, quotes from a German gas journal, in which Prof. Gostkowski claims that a gas car is 24 per cent. cheaper to run than an electric car; that the latter, with overhead wires, has a past, while the gas car has a future; no further information is given.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Parallel Working of Long Lines.—The discussion of Mr. Mordey's paper (see Digest, March 31) is published in the Lond. "Elec.," March 23. Mr. Raworth claimed that the peculiar phenomenon which Prof. Forbes pointed out was not an alternating current effect at all, nor was any electricity involved in it; under the circumstances nothing could happen but hunting; the same thing would have happened if the two engines had been connected by a thin rubber belt over the two flywheels, in which case the slack would have occurred at the top and bottom in regular pulsations. Mr. Sparks said that the synchronizing current depended wholly on the inertia of the moving parts, and that if the speed varied very much during the revolution a very large current was found necessary. Mr. Kapp criticised the analogy with flexible teeth; regarding the V curves (see Digest April 1, 1893), he said they were exceedingly useful if drawn in their entirety; if, in a transmission plant, the resistance of any circuit was small and the self-induction large, the left branch of the V became vertical and then turned over, while the right branch sloped out to a great extent, so far that the machine could not take the great current indicated, on account of heating; in a transmission plant it would be better to excite a little above the point which Mr. Mordey rightly considered the best theoretical point, namely, the bottom of the V; the curves were taken while the machines were running idle and did not represent the true shape, which would be more round at the bottom and the arms would be more curved; if the resistance is small and the self-induction large, it would be advisable to excite the motors higher than the generator in order that they might work at that branch of the curve which sloped indefinitely. He called attention to the fact that in most installations there must be a margin of power which might be gotten by exciting the motor more than the generator, always supposing the line resistance to be low; he mentions an installation in which he had specified three cranks and in which the expansion of each cylinder was adjusted separately. Prof. S. Thompson called attention to a possible importance of a common steam supply to the engines when alternators were running in parallel.

Compound Alternators in Parallel.—In the Lond. "Elec.," March 23, Mr. Mix calls attention to a recent incorrect statement that the Thomson-Houston compound alternators will not work in parallel; in the station at St. Brieuc, two 70-kilowatt alternators over-compounded for 25 per cent. are coupled in parallel regularly and in the most satisfactory manner; they are driven from the same line of shafting; in one case, due to an accident, in which two wires were crossed, the machines were paralleled for three months when they were 180 degrees out of phase, but they immediately came into phase with only a slight flicker of the lights; in another case the exciting current of one dynamo was diminished to a minimum and the other increased to a maximum, and there was not the slightest tendency of the machines to get out of phase; the same was true when the compoundage was changed in one or the other.

Hydro-Electric Installation.—In the Lond. "Elec. Eng.," March 23, is given a brief description taken from the Lond. "Engineer," of the installation at Antwerp, based on the Van Rysselberghe system; as has already been described in these columns, it consists in the transmission of energy in the form of water under pressure and the transformation into electric energy at various distribution centres in the city; the pressure used is 52 1-2 atmospheres; the length of the distributing pipes will be about 7 1-2 miles, and there will be 10 district stations, each embracing a radius of 1,640 feet; very little is said of the electrical features.

Bockenheim.—A translation of the description of the polyphase installation mentioned some time ago in these columns is given in abstract in the Lond. "Elec. Eng.," March 23.

Electric Motors in Berlin.—A list of the motors, classified according to their purpose, is given in the "Elek. Zeit.," March 8; out of a total of 386 motors, representing 1,c85 h. p., 98 are used for ventilation, 74 for printing machines, and 51 for elevators.

Balancing a Three-Wire Station with Only One Machine.—The correspondence on this subject is continued by Mr. Gibson in the Lond. "Elec. Rev.," March 23; he claims that the example of Mr. Thursfield is an extremely rare case, and does not see anything worth considering as a serious practical objection; he works out an example.

Laval Steam Turbine Dynamo.—"Ind. and Iron," March 23, gives a short illustrated description of the 5.5-h. p. combined turbine and Oerlikon dynamo; the speed is reduced from 30,000 to 3,c00, the drop in speed is only 4 per cent. from no load to full load, a three-hour test showed a consumption of 570 pounds of steam, equal to about 34.5 pounds per horse power hour.

Accounts.—In London "Lightning," March 15, is given a method of keeping central station accounts; a schedule is given for weekly reports.

Switch for Circuits Containing Self-Induction.—Mr. Mueller, in the "Elek. Zeit.," March 8, gives a well-illustrated description of a switch for disconnecting circuits containing a great self-induction, as, for instance, the field circuit of a dynamo; the principle of the switch is that just prior to opening the circuit an inductionless resistance is connected as a shunt to the self-induction circuit, so that the extra current is discharged through this resistance; by properly proportioning this shunt resistance, the intensity of this extra current can be limited as desired; if, for instance, it is made double that of the self-induction resistance, the induced voltage at the opening of the circuit will never increase to more than double its normal value; in closing the switch this shunt resistance is first opened; all these operations are accomplished by a single switch lever; one of these shunt resistances will suffice for a number of circuits, and it may be ma le small, as the current lasts but a few seconds.

Incandescent Lamp Drop Suspension.—A new form is illustrated in the "Elek. Zeit.," March 8, for an adjustable balance fixture, in which the difficulties with the securing of the cords and their insulation over the rollers are said to have been overcome.

Socket.—An improvement in the Edison socket is described and illustrated in the "Elek. Anz.," March 9.

WIRES, WIRING AND CONDUITS.

Underground Mains.—In a paper by Mr. Clirehugh, reprinted in the Lond. "Elec. Eng.," March 16, and abstracted in the "Electrician," March 16, he discusses chiefly the various insulating materials. Gutta-percha is not suitable; india rubber he recommends very highly; for making joints with pure rubber he recommends that after 20 or 30 are ready an experienced vulcanizer should be employed to vulcanize them; the only objections to india rubber are its high price and the difficulties of making joints; he warns engineers against purchasing low priced rubber cables; the bittite used by the Callender company is believed to be bitumen refined to purity and vulcanized; the jointing is very simple; he gives no opinions regarding it; it is used chiefly for low tension currents. A table is given showing the cost per yard for a number of different systems, but being in English prices it is of little interest to Americans. Regarding another class of cables, in which the insulating material must be protected by a metallic envelope, he is decidedly of the opinion that such cables answer equally well if treated with sufficient care, the price being lower than that of rubber. He believes it is better not to insist on too high an insulation, but to insist on its being uniform, high insulation being often obtained at the expense of the life; such cables should be tested after immersion with at least double the voltage for which they are intended; such cables should be taped or braided when drawn into pipes and if heavy should be lubricated, for which there is nothing better than soft soap; a good temporary way of sealing the end of a cable is to tape it with dry cotton tape and plunge it into hot pitch; the difficulties in connection with such cables are largely overrated, and with good care they are as good as india rubber cables, the jointing being simpler; he thinks paper insulation has an advantage in the cleanliness of the jointing; its power for resisting disruptive discharges is very high, 1-4 of an inch being sufficient to stand 20,000 volts, which he thinks no other dielectric will stand; regarding the Brooks oil insulation resistance, which he describes, he points out the difficulty in getting the oil out to make a joint; it might be suitable for feeders, but not for distributing mains. Armored cables are not as cheap as is often supposed; they may be good for outlying districts, but there are many objections to their use, the principal one being the difficulty in fault finding; in conclusion he describes the Crompton system of uninsulated mains.

Underground Mains.—A paper by Mr. Rider is reprinted in the Lond. "Elec. Eng." and "Elec. Rev.," March 16, and abstracted in the Lond. "Elec."; he discusses the subject in general, giving, however, nothing new. On the distributing mains from the feeding point to the houses there should not be a loss of more than 2 per cent.; in an ordinary business street the feeding points should not be more than 750 feet apart; in no case should a feeder supply more than one feeding centre, as it would then be impossible to regulate for the loss in the feeder; each feeder should be regulated independently; a drop of 10 to 20 per cent. may be allowed for the feeders; he recommends a combined system for feeders, in which some lines are buried permanently and other portions are drawn in through tubes; regarding alternating current lines he states that there is only one perfect cure for the induction of the wires on each other, and that is to make them concentric; he thinks too little attention has been given this and that there is a great unknown waste of power in such systems, being equal, he believes, to the magnetizing current losses of the transformers; he shows from some recent specifications how little this subject is understood even by capable firms; in a cable made by Siemens, three separately insulated conductors are twisted together, and then covered with lead and armored; the effect of the twisting is the same as making them concentric, while the making of joints becomes much simpler; he mentions a system in which there are only two primary wires, but three secondary wires, forming a three-wire system, the middle wire being connected to the middle of the secondary; bare wire conductors should be used only for continuous low tension currents, for if used with alternating currents it is practically impossible to avoid induction effects; the insulation resistance in these, he says, is often a minus quantity.

The discussion of the above two papers is published in the Lond. "Elec.," March 23. Mr. Wordingham thought the difficulty of vulcanizing joints had been exaggerated, as there was very little difficulty in vulcanizing joints properly. Mr. Mountain thought cables which were insulated with bitumen, paper or fibre might be very good for low tension mains, but were unsuitable for high tension works unless laid with great care and great expense; if cables were laid in ground where there were traces of ashes he had found considerable trouble. Mr. Taylor also thought the difficulty of making rubber joints had been overestimated. The discussion is given somewhat more in detail in the Lond. "Elec. Eng.," March 23.

Conductors for Mines.—The Lond. "Elec.," March 23, translates a paper by Mr. Libert from a Belgian journal, describing cables for mines in which firedamp exists and where it is necessary to avoid the possibility of a spark. Concentric conductors, when well insulated and covered with a strong armor, may suffice for most cases; the safety might be increased by running them in iron pipes to avoid crushing. He describes the Atkinson, Charleton and the Noblet cables, in which instead of a simple protection, arrangements are devised by which the sparks are produced in closed chambers; in the latter, which he describes and illustrates more at length, and which he appears to recommend, there is a central auxiliary wire traversed by a current in a different direction from that of the concentric main conductor; each cable is divided into sections and connected by sliding caps, such that when the cable is stretched, the auxiliary wire is broken first, and by means of electromagnets in circuit, the main current is immediately disconnected; in case of the cables being crushed, the auxiliary and main wires come in contact, which causes a current to pass through the electromagnets, resulting in the opening of the circuit; two illustrations are given of this cable.

Fusible Cut-Outs.—In the second part of Mr. Anney's article in "L'Ind. Elec.," March 10 (the first part of which was abstracted in the Digest March 31), he discusses fuses which are contained in glass tubes mounted at the ends with metallic caps, contacts being made with spring clamps; for 1 to 2 amperes extremely fine silver wire is used, for 5 amperes a copper wire between Nos. 32 and 33 B. & S. gauge, and for any multiples of 5 a corresponding number of these wires are used in multiple; the advantage over lead is that the mass of metal is much less, producing less of a shock on fusion. Regarding the material for the base of such fuses he states that wood is out of the question, slate absorbs moisture and is apt to contain conducting substances, hard rubber changes its shape and carbonizes under the influence of the heat, vulcanized fibre absorbs moisture, glass is very good but is difficult to manufacture, marble is an excellent material if there are no veins through it, faience has the advantage of being cheap, but is too porous, being apt to absorb moisture, and the glaze with which it is covered decomposes by the heat of the fuse; porcelain, he

says, is the only material which most nearly meets all the required conditions.

Steamship Lighting.—In the Lond. "Elec. Rev.," March 23, Mr. Mavor explains that Mr. Kennedy confuses single wiring with concentric wiring and that he recommends the latter.

Bronze Wires in Telegraphy.—The "Elek. Zeit.," March 22, contains an article by Mr. Mueller, forming a part of the discussion on this subject.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Simultaneous Telegraphing and Telephoning.—In the "Elek. Zeit.," March 8, Mr. Christianie discusses the well-known method in which the relays are wound with a double winding, thus having the additional property of an induction coil, so that both telegraph and telephone currents can be sent through it; he states that many difficulties are involved in such a system, even though the principle is very simple, but it can be used to advantage for telephoning in the unavoidable intervals between telegraphic dispatches; the complete connections for such a system are given.

Telegraphing Without Wires.—In "Cosmos," March 3, Mr. Michel illustrates and describes a method in which both circuits are through the ground, being through different strata of the earth, having a more or less good insulating stratum between them; he has been able to speak for a distance of about 400 feet, while telegraphic signals can be sent through 1,500 to 3,000 feet.

Telephone in Germany.—A long paper by Mr. Muench, describing the evolution of the telephone system in Germany, is reprinted in full in the "Elek. Zeit.," March 22. From the statistics which he gives, it appears that Berlin has the greatest number of subscribers of any city in the world, there being 20,949, next come Chicago with 9,684 and then New York 9,066, Hamburg 8,303 and London 6,700.

Telephone Switchboard.—The Mix and Genest switchboard, which was adopted several years ago by the German Government, is described quite fully, with the aid of thirteen illustrations, in the "Elek. Zeit.," March 22; an abstract would be of very little use; the illustrations are very clear; it will be remembered that this system was adopted after careful comparison with the others in use and is praised very highly. Several systems and details of other switchboards are given in "La Lum Elec.," March 24.

Communication with Lightships.—According to the Lond. "Elec." and "Elec. Eng.," March 23, the first permanent lightship cable has been successfully laid and communication established with the Kentish Knock Lightship.

Multiple Telegraphy.—The "Bul. de la Soc. Int." for February contains a very long illustrated paper by Mr Baudot (whose system is used largely in France).

Controlling Signals.—A well illustrated paper by Mr. Prasch on a new method is published in the "Zeit. fuer Elek.," March 15.

ELECTRO-CHEMISTRY.

Electric Preparation of Tungsten.—According to the Lond. "Elec. Rev.," March 23, the Krieg process consists essentially in preparing the chloride by using electrodes composed of scheelite or wolfram and carbon for the production of an arc in the presence of chlorine; the chlorides are extracted in the form of sublimates, from which tungstic acid is prepared by treatment with hydrochloric acid, which decomposes the tungstic chloride and other metallic chlorides; the tungstic acid is freed from silica by means of "electrization," and is finally made into electrodes with carbon and reduced to metal in a closed electric furnace.

Rhodium.—According to London "Lightning," March 15, recent experiments have shown that rhodium is admirably adapted for electroplating copper and iron, the former taking the metal more easily and the latter acting better when oxidized; a suitable bath consists of 100 grams of rhodium sulphate dissolved in one litre of water, to which is added 100 g. of ammonium fluosilicate, 100 g. of ammonium chloride and 50 g. of ammonium cyanide.

Separation of Cerium.—An electrical process for separating cerium from lanthanum and didymium is briefly described in Lond. "Lightning," March 15.

Steel Plating.—A process of plating copper and zinc plates for printing, with iron, in order to increase the number of impressions which can be taken from them, is described in "L'Elec.," March 17.

Circulation of the Electrolyte.—In London "Lightning," March 15, Mr. Gibbings states that he has found it extremely important to provide for an absolute steady circulation of the electrolyte in the deposition of copper, and calls attention to the importance of such circulation in accumulators; he claims to have devised an apparatus for providing such circulation, but does not describe it.

Purification of Sewage.—The Hermite process is discussed in "Ind. and Iron," March 23, where attention is called to impurities in the air in the sewers which may not be purified by the liquid; also that materials like paper absorb considerable of the chlorine without being disintegrated, thus representing a considerable amount of useless work. "Ind. and Iron," March 16, gives a number of illustrations of the plant and details as installed in the city of Nice; the description contains nothing new.

In the abstract in the Digest, March 31, the statement that the positive terminals were made of "rods of brass wrapped with platinum gauze" should read "rods of glass," etc.

Theryc-Oblasser Accumulator.—In the Lond. "Elec. Rev.," March 23, Mr. Everard gives the results of a test, giving 33 ampere hours and 64 watt hours per kilogramme of plates, the total discharge being 156 ampere hours, the total weight of plates 6 kilogrammes and the discharge rate 7 1-2 amperes per square foot of positive surface.

Accumulator.—A modified form of Plante accumulator is described and illustrated in "L'Elec.," March 17; the plates are made of pieces resembling an ordinary comb, the teeth of which fit into each other.

Plane of Polarization.—The Lond. "Elec. Eng.," March 23, abstracts briefly an article by Mr. Humburg, from a German chemical paper on the "Electromagnetic Rotation of the Plane of Polarization of Acids."

Polarization of a Thin Metal Partition.—The second paper of Mr. Daniel is published in the "Phil. Mag." for March.

Chemical Action of a Reversed Electrolysis.—The Lond. "Elec. Rev.," March 23, discusses the subject briefly, with special reference to Prof. Armstrong's views.

MISCELLANEOUS.

Electricity in Animal Life.—A paper by Mr. Solvay on electricity in the phenomena of animal life is begun in "La Lum. Elec.," March 17.

Phonograph and Microphone in Medical Studies.—The Lond. "Elec. Eng.," March 9, calls attention to a recent paper by Dr. Macintire, in which he expresses the belief that the phonograph will soon be used in medical teaching; he has been able to record a number of cough and heart sounds; he exhibited microphones for enabling a number of students to listen to the sounds of a body which may be in a hospital at a distance.

Educational.—Under the heading of "A Technical Utopia," the Lond. "Elec. Rev.," March 23, describes the Currie Engineering School, which it praises very highly; three full pages of illustrations accompany the article. The same

number contains a short description of the Telegraphists' School of Science. The course at the Institute at Frankfort, Germany, is given in the "Elek. Zeit.," March 8. The course of the Mechanics' School of Electricity in Vienna is given in the "Zeit. fuer Elek.," March 15.

Thermo-Pile.—The present form of the Guelcher thermo-pile, as now made in London, is described and illustrated in the Lond. "Elec. Eng.," March 23; it is claimed that with 66 elements, having an internal resistance of 0.65 ohm, a current of 3 amperes at 4 volts is obtained when the external and internal resistance are equal, the consumption of gas not exceeding 0.064 cubic foot per hour, which corresponds to about 10 1-2 cubic feet per kilowatt hour of useful energy, bringing the cost down to an exceedingly low amount.

Tempering.—As the edge of knives and scissors should be hard and the rest of the blade sufficiently soft to be elastic, the "Elek. Anz.," March 22, suggests that the Lagrange & Hoho process for tempering might be used to advantage, only the edge of the blade being immersed in the liquid and brought to a red heat.

Biographical.—A biographical sketch of Hiram S. Maxim is published in "Ind. and Iron," March 23.

The General Electric Company at the Midwinter Fair.

The representation made by the General Electric Company at the Midwinter Fair, while, of course, considerably less important than that made by them at Chicago, from the point of view of mere quantity, is still the most important among the electrical exhibits which are now supposed to be delighting our Western brothers by the Golden Gate. The display of its purely mechanical exhibit is made in the Palace of Mechanical Arts, and the space allotted is occupied by many of the later types of its machinery, apparatus and instruments, the major portion being devoted to a fine exhibit of electrical mining and power transmission apparatus.

The chief use of electricity on the Pacific coast is to transmit power to the cities and towns for railway and lighting work, and to the mining centres for the operation of the different electrical mining apparatus, such as drills, crushers, pumps, etc. The field of power transmission is very wide in the states west of the Rockies, where coal is extremely costly, but where, on the other hand, there are many available water-powers which are fast being utilized.

Among other apparatus the General Electric Company exhibits the following:

A three-phase rotary four-pole transformer similar in design to those now in use at Redlands, Cal., and to those which will be used at Niagara Falls. It resembles a continuous current transformer in which the primary and secondary are wound on the same armature. It is wound for a potential of 200 volts at the receiving or motor brushes, while the potential of the three-phase current is 500 volts.

The most important feature is a complete three-phase power transmission plant. The generator is of 35 kw. capacity, and is driven by means of belting by a 35 kw. bipolar motor. The current of the generator is led to a switchboard containing the usual set of instruments, such as Thomson-Houston indicators, recording wattmeters, switches and fuses, and the "line" is carried on oil insulators, after having been transformed in the step-up transformers from a potential of 300 to one of 6,000 volts, to the switchboard of the receiving station. Step-down transformers are there employed, which reduce the voltage to 300, under which pressure the current is delivered to a 10-h. p. three-phase motor, which is belted to what is generally termed a "drill" generator, a dynamo having rotary brushes, used to operate percussion drills. The drill exhibited is of the General Electric percussion drill type. Connection is made by means of a cable armored for its better protection in mine work.

A 10-h. p. mining locomotive, 24-inch gauge, and equipped with two 500-volt iron-clad motors, also forms part of the exhibit. This locomotive is well adapted for mine work, as it is built very low, for entrance into low gangways. The seat for the motorman is in front, and all operations, such as starting, stopping, reversing, applying sand to the rails, etc., can be quickly done, the handles of the levers for these operations being all within easy reach. Two 16-c. p. lamps in a reflector form the headlight.

Portable mining outfits are also shown, one consisting of a special motor running a swivelled diamond drill by means of bevel gears, which can be thrown out of mesh so that a friction clutch allowing of connection of the motor to a hoist can be thrown in, the motor serving for the two different operations. On the same truck with this apparatus is also mounted a 3-kw. Edison motor, connected to a triple Gould pump.

There are also set up and in operation a rotary pump, driven by means of a rigid coupling from a 3-kw. Edison motor mounted on the same base, the pump delivering about 300 gallons a minute; another portable pump outfit, consisting of a 3-kw. T.-H. motor connected by two intermediate gears (the pinions being of rawhide) to a Gould triplex pump, delivering about 100 gallons a minute, the whole being mounted on a truck; a 10-h. p. sinking pump for deep mine work, perfectly water-tight. All these pumps are working with very little noise and vibration.

A board filled, in regular style, with instruments, such as wattmeters, indicators, fuse blocks, railway supplies, etc., a few fan motors, which attempt to make things lively by means of colored ribbons attached to their frames and floating in the air currents produced; a 24-inch projector, marine type; four large ball clusters on poles, containing each forty 16-c. p. lamps and two cubes of fifty-four 16-c. p. each, complete the exhibit so far as the Exposition space proper for the company is concerned.

A 200-kw. railway generator furnishes current for cornice lighting, the lamps being connected five in series, as well as for the motor of the tower elevators. This is driven by a double piston valve engine of the Joshua Hendy Machine Works, San Francisco, cylinders 14 inches by 18 inches, belt connected. This dynamo is on the opposite side of Machinery Hall, near the boiler house, where are also eight Thomson-Houston arc light machines, each of 50 lights. These are driven, four each, from two counter-shafts which in turn are belted, one to a Buckeye automatic cut-off slide valve engine of 200-h. p., 140 revolutions; cylinders 14 inches by 24 inches (the speed being controlled by the isochronal regulator); the other one to a 150-h. p. Russell engine of 190 revolutions, cylinder 13 inches by 20 inches, and fitted with the Russell automatic cut-off slide valve and flywheel governor.

The Annex shelters a 50-kw. Edison dynamo, supplying current for the electric fountain and the searchlight on top of the electric tower. This machine is belted to a 250-h. p. tandem I. F. Thompson slide valve engine, manufactured by the Golden State and Miners' Iron Works, of San Francisco. Nearby is a 6,000-light alternator, driven through the intervening medium of a countershaft from a 500-h. p. Corliss engine of 80 revolutions per minute, and cylinder 22 inches by 48 inches.

The searchlight on top of the electric tower is that which was exhibited at Chicago. It is a 60-inch projector with a Mangin spherical mirror, and is one of the largest in the world. The fountain is one of those which played at the World's Fair, and has been fully described in these columns. In its new position it is much better situated for display, and is not subjected to the violent competition of surrounding white buildings and blaze of light.

A Non-Arcing Railway Lightning Arrester.

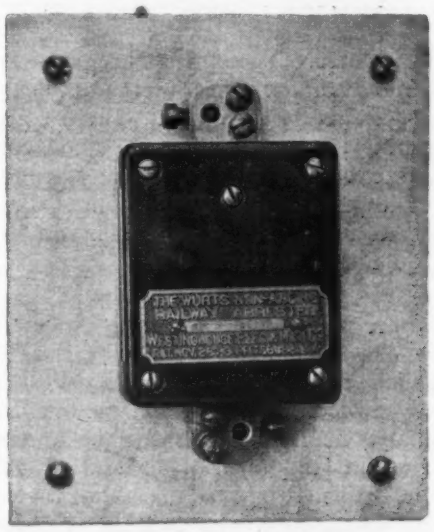
The fundamental principles of the Wurts non-arcing lightning arrester, manufactured by the Westinghouse Electric and Manufacturing Company, are based upon the following facts:

1. That a static discharge will leap over a non-conducting surface, such as glass, wood, marble, etc., more easily than through an equal air space. If a pencil mark be drawn over this non-conducting surface the discharge will take place still more readily.

2. That a dynamo arc in order to be maintained must be fed by the fumes or vapors of its electrodes—conversely, therefore, that in order to avoid the formation of a dynamo arc between electrodes means must be taken to prevent the formation of these conducting fumes.

An electric spark which springs across an air gap does not pass like ordinary moving matter, gently pushing the air aside. Its passage is so instantaneous that the air is shattered, so to speak; the spark crashes its way through the air like a bullet through a pane of glass. If, however, the air be previously split—electrically split—the spark will pass with ease. A pencil mark over ground glass or a charred groove in a wooden surface forms an electrical crack or entering wedge through the air so that an electric discharge finds a much easier path over this surface and through this electrical crack than it does when it is forced to bore its own way through the air medium.

In the non-arcing railway lightning arrester the discharge



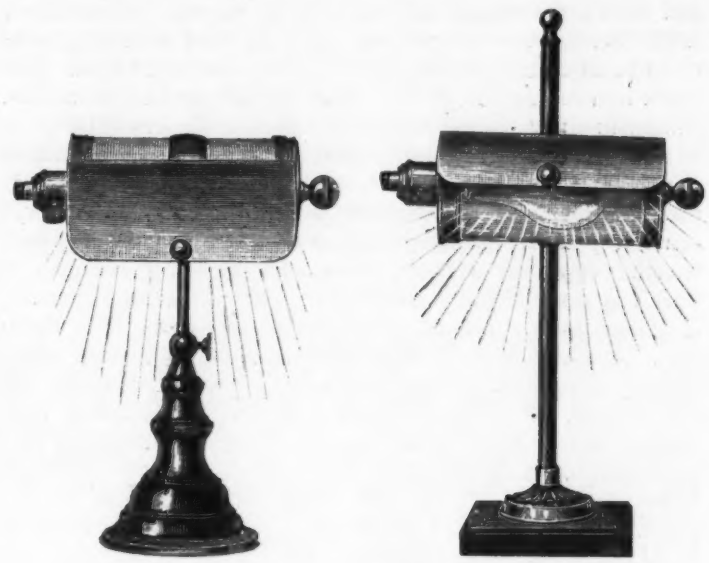
RAILWAY LIGHTNING ARRESTER.

is caused to pass between two brass electrodes separated by half an inch and over narrow grooves burned into a block of lignum vitae. It must not be understood that this charred surface in any way acts as a conductor in the ordinary sense of the word. The discharge takes place not by conduction, but by disruption, leaping between the electrodes and over the charred surface, the latter acting simply as an electrical crack through the air and thus greatly assisting the passage of the electrical discharge; neither does this charred surface leak dynamo current, for the ohmic resistance between the electrodes is more than 50,000 ohms. If now a solid lignum vitae block be firmly screwed down over the charred grooves and metal electrodes it will be impossible for conducting vapors to form and the device is at once a non-arcing lightning arrester.

The arrester, which is herewith illustrated, has been thoroughly tested, we are informed, during the past season in the western sections of this country, which are noted for their frequent and violent thunderstorms, and in every instance has proved all that is claimed for it.

New Form of Desk Light.

Since placing the Kinsman desk light on the market, which was designed for roll top desks, the manufacturers, McLeod, Ward & Co., 91 Liberty street, New York, have had numerous inquiries for lights of this style for other purposes, and have found it necessary to make a portable lamp for flat desks, etc. The illustrations herewith show two styles, Fig. 1 being of a somewhat more ornamental style than Fig. 2, although both present a very neat appearance. Both shades can be raised and lowered as desired in a

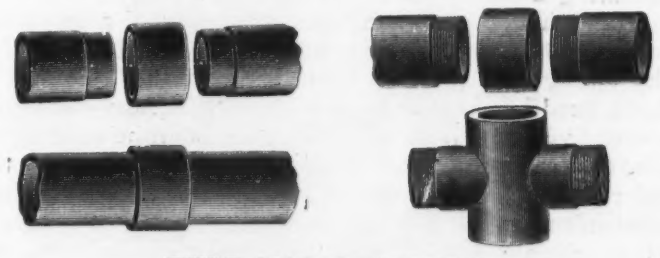


FIGS. 1 AND 2.—DESK LIGHTS.

similar manner to the ordinary portable. No. 1 is shown with the eye shade down, the rays of light being thrown directly underneath, while No. 2 is shown with the eye shade up, the rays of light from it being thereby thrown horizontally and perpendicularly. This eye shade is adjustable the same as in the desk light, the glass cylinder being revolved by a slight touch for the purpose of modifying the light, two-thirds of the glass being ground and one-third clear.

A New Conduit.

A fibre conduit for underground electrical purposes is being placed on the market by the Fibre Conduit Company, 45 Broadway, New York, and extensive preparations have been made for its manufacture on a large scale in view of the tendency, accelerated by the action of municipal governments, toward placing all electrical wires underground. The



FIBRE CONDUIT FITTINGS.

conduit is made of wood fibre, treated with an insulating and preserving compound, which produces a hard and solid substance, and is made into tubes by a machine designed for the purpose by Prof. Henry Fairbanks and Mr. Howard Parker, of St. Johnsbury, Vt. The tubes are completely saturated with the treating mixture, which has been prepared under the direction of eminent chemists. The fin-

ished pipe, in 5-foot lengths, is uniform in thickness, with smooth surfaces, and is made in a number of standard sizes, with the necessary regulation fittings (several of which we illustrate), section boxes, etc. Two standard joints are made, one a socket and the other a screw joint, and also, when required, a special socket joint which is wholly in the pipe, thus not increasing the outside diameter.

The weight of the finished product is less than one-third that of iron pipe of the same size. It is claimed that the conduit is practically imperishable when laid in the ground. As it is non-absorbent, it is not affected by acids or alkalies and does not contract or expand with varying temperature; it is, therefore, free from the splitting and checking, corrosion and disintegration, which injure wood and iron. Being a non-conductor, there is none of the electrolytic action, which, in many cases, affects metal pipe so seriously.

The material is tough, elastic and strong. Standard 3-inch pipe will safely bear a crushing weight between two plane surfaces of 800 pounds per lineal foot, and it will stand a pressure of 450 pounds at the centre of a 5-foot length supported at both ends. Its bursting strength is over 125 pounds per square inch. As to insulation, we are informed that conduits seven-sixteenths of an inch thick have been tested on a 20,000-volt alternating current without any perceptible effect. Moisture does not condense on the surface, as in metal pipes, and it is claimed that bare copper can be used in the conduit to great advantage and with any working voltage. It is easily cut with ordinary tools, and joints, fittings, etc., may be introduced at any point. The joints are both strong and tight, unlike those of some other electrical conduits.

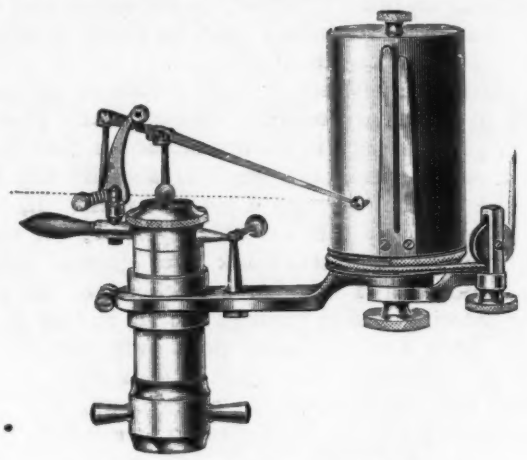
A mill for the manufacture of the above conduit has lately been constructed at Orangeburg, N. Y. The factory is located on the West Shore, Erie, and Ontario and Western railroads, and has, therefore, fine shipping facilities, while the buildings are equipped with all the modern appliances and machinery run by electric power.

Improved Straight Line Indicator.

The peculiarity of the indicator illustrated, manufactured by the Hine & Robertson Company, 68 Cortlandt street, New York, lies in the simplicity of its parallel motion device, and in the auxiliary spring that allows it but one working surface, thus preventing the appearance of any backlash. These two features admit of lightness of the moving parts throughout and the placing of the guiding mechanism near the fulcrum, so that it may have little movement, thus reducing the momentum of the moving parts to such an extent that it is no longer a disturbing element at high speeds. The auxiliary spring prevents any looseness appearing, and thus impairing the accuracy of the indicator.

The guiding mechanism consists simply of a small cam fastened to the pencil arm, the face of the cam being held by the spiral spring, at *E*, against the roller. This roller has a fixed bearing on the upright, between the connecting rod and vibrating link, as may be seen from the same figure. The cam rocks upon the roller, and is so shaped as to cause the pencil point to move in a straight line. The guiding mechanism, it will be seen, is placed so near the fulcrum as to obviate a high surface velocity of the cam, and the moving parts simply rock back and forth upon each other, turning almost upon the same point of contact while taking a card of average height. This will give a perfectly straight line throughout the whole range of its movement. It will be noticed by reference to the cut that the two links will be parallel with each other at all points of the stroke, and that the lower pivots of these links will be always in a straight line with the pencil point, thus forming an exact pantograph, without depending on the piston rod for a guide. It will also be seen that the movement of the pencil coincides with that of the piston at all times, a point of very great importance, which every intending purchaser should carefully consider.

The drum is made as light as possible, with a bearing at both ends, the drum spring being ground concave on the sides to avoid all frictional resistance in the drum. The drum spring can be set to any tension desired by first removing the drum, unscrewing the milled nut upon it, and loosening the thumb nut inside, when the spring may be tightened by turning the milled disc to any position. The groove for the cord is so arranged that there is but one turn of the cord on the drum, preventing the distortion when



STRAIGHT LINE INDICATOR.

the cord runs double. The springs are provided with heads that take a firm hold on the outer coils, leaving nothing but the free coils to do the work. These coils are ground in such a manner that the spring will stand compression to the fullest extent without showing any tendency to bind sideways. The piston rod is made hollow, and threaded to receive a swivel rod so that this pencil can be adjusted to any height on the drum.

A Wireman's Soldering Stick.

A convenience that will be appreciated by wiremen has been recently placed on the market by the Electric Appliance Company, Chicago, consisting of a soldering compound put up in the form of a round stick 6 inches long and 1 inch in diameter, and having about the consistency of sealing wax when cold. In making a joint, the Allen soldering stick, as it is called, is merely rubbed on the hot wire, when it melts, producing a bright surface, to which the solder adheres with great readiness. The advantage over soldering fluids in handling is obvious, as well as the gain in time, and the makers claim that, unlike many fluids, the compound will not corrode the joint or affect the surrounding insulation.

The great waste in soldering fluids from the manner in which they are often applied, and from the frequent overturning of bottles, and the deleterious action that often results, are all obviated by this new convenience.

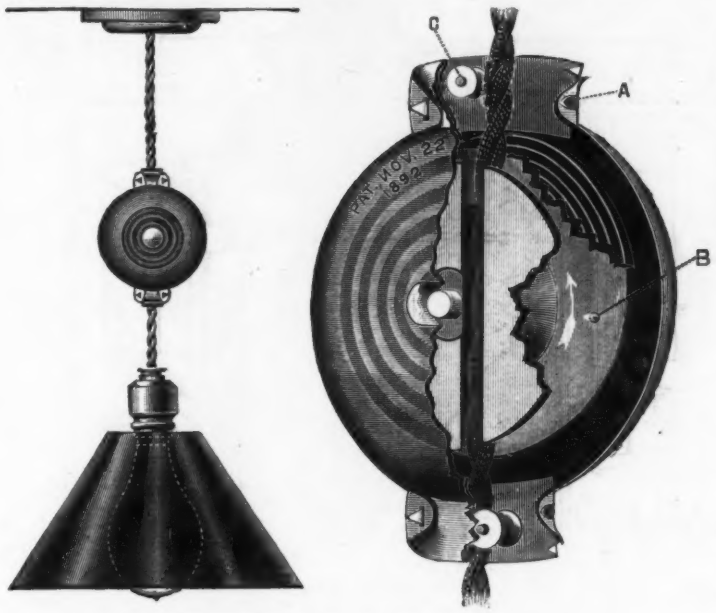
A Correction.

In an article on the Thomson recording wattmeter for arc circuits, printed in our issue of March 17, it was stated that the safety cut-out "is designed to close immediately on trouble occurring within the meter." This should have read "The cut-out is designed to close in case of any trouble on the circuit which the meter is measuring. On closing, this device cuts out both the meter and the lamps upon it and serves not only as a protection to the meter, but to the lamps which it is measuring. A rise in potential around the lamps,

which are being measured, sufficient to cause trouble will throw this cut-out into action and absolutely preclude any danger to the meter or its circuit."

Incandescent Lamp Adjuster.

The pendent lamp adjuster we illustrate, manufactured by Stephen Porter & Co., 384 Atlantic avenue, Boston, and

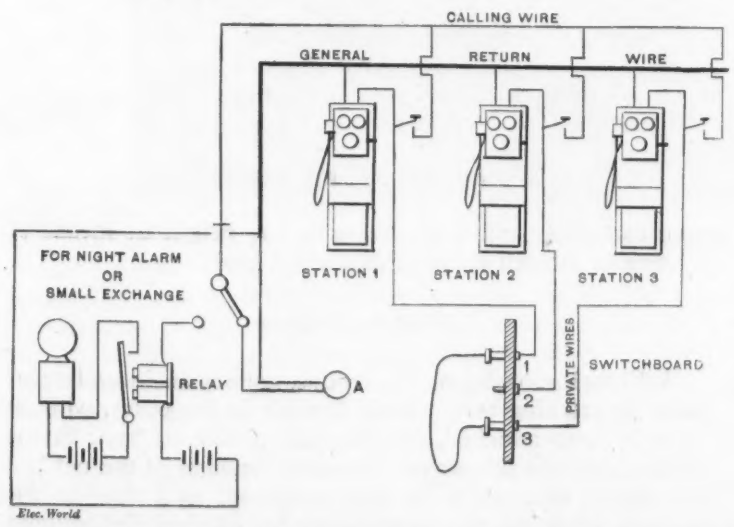


PENDENT LAMP ADJUSTER.

for which George L. Colgate, 136 Liberty street, New York, is selling agent, depends for its action on a spring instead of on that of a differential pulley, as with other forms of adjusters, thus reducing the wear on the conductor incident to the use of the latter. To attach the adjuster, one-half of the shell is removed and the conductor pressed into the slot shown. The shell is then replaced and secured by binding down firmly the four points, *A*. To adjust, if necessary, the spindle is turned back or forward the necessary number of turns and held in its new position by the pin *B* until the shell is replaced, when the pin is removed. Readjustment is only necessary in special cases, as the spring is properly adjusted at the factory for ordinary applications.

National Telephone System.

We recently described the little compound receiver tele-



NATIONAL TELEPHONE EXCHANGE SYSTEM.

phone of the National Telephone Manufacturing Company, Boston, and illustrate herewith a new combination just placed on the market by that company, comprising a receiver, transmitter and magneto bell, all in one box.

We also illustrate the telephone exchange system of the same company. One wire, as shown, is carried from the switchboard to each subscriber; a general return wire and calling wire, connected to the operator at *A*, gridirons the exchange territory, each subscriber tapping on to both of them. If the person at station No. 1, for example, wishes to talk to station No. 3, he takes the receiver from the holder, places it to his ear and pulls down the cord at the bottom of the bell box; this connects him with the calling wire leading to *A*, where the operator complies with the order to connect to No. 3 by making the necessary connection on the switchboard. When the cord in the station box is released by the operator a sharp click is heard, which is a signal that the call has been heard and the desired connection made. No. 1 can then ring up and talk direct to No. 3, the operator being cut out and unable to hear the conversation. While a grounded circuit can be used, the metallic circuit shown is, of course, far superior.

The Queen-LeChatelier Pyrometer.

Modern investigation and many of our modern industries demand an instrument for the accurate measurement of very high temperatures. A vast amount of experimental work in this line has been done by physicists and metallurgists in the past, their most noteworthy results having been achieved by the employment of the air or gas thermometer, which depends for its action upon the expansion of air instead of mercury, as in the ordinary forms of thermometers. The bulbs of these thermometers they constructed of materials like glass or platinum, whose melting points are very high. In the more recent experiments, however, porcelain bulbs were used. These air thermometers are not convenient or practical instruments, requiring, as they do, a great deal of subsidiary apparatus and the application of many corrections to the readings. With them, however, eminent scientists have done us invaluable service by establishing many fixed temperatures, such as the melting points of various metals. These may safely be relied upon in graduating other forms of pyrometers.

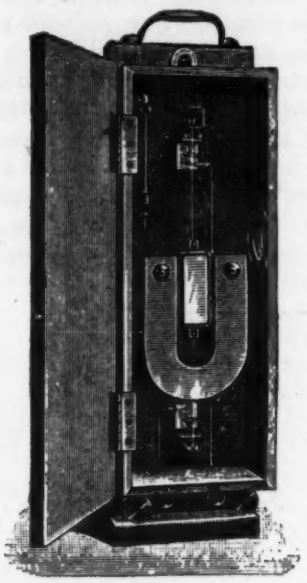
M. Le Chatelier, in constructing his pyrometer, has made use of these known melting points. It is based upon the principle of measuring the electric current generated by the heating of a thermo-electric junction. As modified by

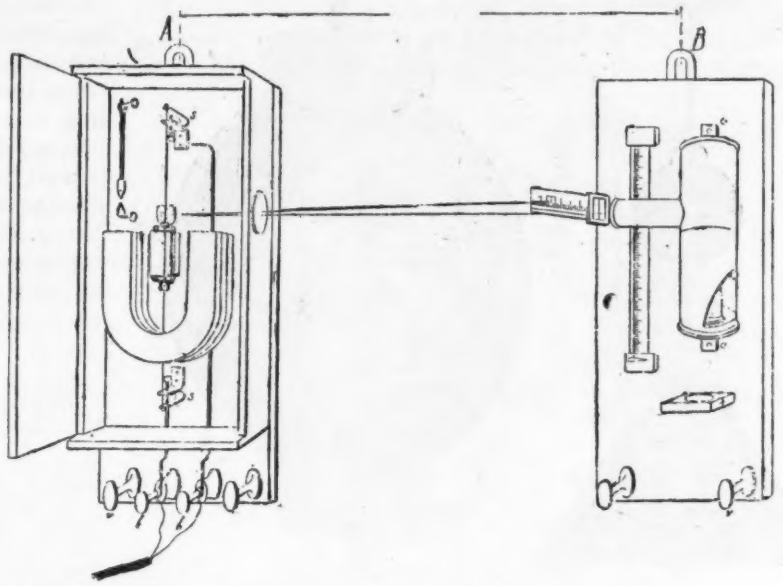
COMBINATION RECEIVER, TRANSMITTER AND MAGNETO BELL.

Queen & Co., it consists of a thermo-electric couple and a d'Arsonval galvanometer. The wires which compose the

couple are one of pure platinum, and the other platinum alloyed with 10 per cent. rhodium, both of which are perfectly homogeneous. For use, the couple, which has been first connected with the galvanometer, is inserted into a furnace or oven, when immediately a current is produced and measured on the galvanometer scale, from which the temperature is readily deduced.

The following advantages are claimed for this pyrometer:





FIGS. 1 AND 2.—IMPROVED PYROMETER.

First—It is adapted for a very large range of temperature, i. e., from 200 degrees to 3,000 degrees Fahr., but is intended more specially for high temperatures, such as are met with in the manufacture of metals, chemicals, porcelain ware, etc. Second—It is almost instantaneous in its indications, five seconds being sufficient time to subject the couple to any stationary temperature; or the couple may, if desired, be left permanently in the furnace or oven, indicating at all times the temperature, and thus enabling the operator to keep an hourly record of same. Third—The metals which compose the couple are not affected by gases, and hence will not become oxidized or react chemically on each other at high temperatures; nor are they altered in their thermo-electric properties by rough usage or bonds.

From the above statements it will be readily seen that the instrument is of great accuracy and durability. The measurement of the temperature is made by means of a d'Arsonval galvanometer, contained in two wooden boxes, which are screwed against a central wall or slab with handle, for portability, as shown in Fig. 1. Fig. 2 shows the two boxes unscrewed from the central slab and placed in their respective positions against the wall. Box *A* contains the galvanometer proper, and is also provided with set screws and a small plumb bob, so that it may be set vertically. Box *B* contains the lamp, having a lens and window with cross-hairs for throwing an image upon the galvanometer mirror in box *A*, which in turn reflects it back upon the scale in box *B*. Box *B* has also two set screws for adjusting it vertically. The two boxes are set one metre apart.

The current set up by the thermo-electric couple (no battery is used) enters the galvanometer through the two binding posts, box *A*, and the deflection caused by it is shown upon the scale, box *B*. This scale is graduated in millimetres, and it is necessary, therefore, that a curve be made reducing these millimetres to degrees Fahrenheit or Centigrade. This curve is very simply made from known melting points given herewith: Water boils, 212° Fahr.; lead melts, 617° Fahr.; zinc melts, 779° Fahr.; gold melts, 1,913° Fahr.; palladium melts, 2,732° Fahr.

Trolley Tower Wagon.

The convenience of an adjustable wagon tower, which can also be dropped out of the way in driving through the streets, is apparent, and is very efficiently attained by the one we illustrate, manufactured by S. E. Hartman, Worcester, Mass. The tower can be attached to any express wagon, or is supplied with a special wagon. The latter has a seat hinged to turn over forward out of the way and is provided with a tool box; there is one elliptic spring forward, and the wagon has low wheels in order to permit a short turn, and two heavy elliptic springs behind to steady the tower. One

TROLLEY TOWER WAGON.

man can easily adjust the tower to any height by means of a crank or wrench attached to a worm gear.

Electric Fishing.

A French electrician, M. Trouve, applies an incandescent lamp to catching fish. A net is sunk in the water, with an electric lamp attached, and the fish collect to bask in the rays of the new illuminant. Round the edge of the net is a pneumatic tire, which is silently inflated and rises to the surface while the fish are wondering whether the brilliant glass bulb is a new kind of luminous jelly fish. M. Trouve's ingenious idea seems hardly sportsmanlike, but it at least avoids frightening the fish and destroying the spawn—the chief drawbacks to net fishing.—London "Lightning."

Indestructible Insulator Pin and Triple Petticoat Insulator.

The insulator pin we illustrate possesses the advantage of being indestructible, easily attached, and instead of splitting the cross-arm, as does the ordinary driven wood pin, rather tends to preserve it. These pins will stand a strain of 1,800

INSULATOR AND PIN.

pounds, while oak and locust pins break at 700 and 900 pounds respectively. The triple petticoat insulator shown, manufactured by the same firm, Fred. M. Locke & Co., Victor, N. Y., is especially suited where high insulation is necessary, as it has an unusual length of insulating surface. This insulator has been largely used on high tension lines (up to 10,000 volts) and another style is made which, it is claimed, can be used with voltages up to 35,000.

Electric Mine Haulage Plant.

Concrete examples of the adoption of electricity to the exclusion of all other methods are generally more convincing in their import to the public mind than mere hearsay or description. The illustration shows a striking example of the supersession of older haulage methods by the electric mine locomotive in a coal mine in Pennsylvania and emphasizes the vast advantage which its use confers.

The mine in question is the Bear Run mine of the Blossburg Coal Company, near Landrus, Tioga county. The locomotives, of which there are two, are of the T. M. M., that is, "two motor mining" type, each of 30 h. p., manufactured by the General Electric Company. They are propelled by two W. P. 30 motors, one being geared to each axle. Current is brought to the motors by a specially designed trolley arm, on which the trolley wheel is swivelled to permit of its adjustment to the various irregularities of the wire line. The trolley arm can be set in sockets on either side of the locomotive, which may thus be run into headings on either side of the main haulageway, which is lighted by incandescent lamps, placed at the entrance to each cross-head, 100 yards apart. The dimensions of the machines are: Horse power, 30; speed, 6 miles per hour; draw-bar pull, 1,500 pounds; gauge, 36 inches; wheel base, 30 inches; diameter of wheels, 28 inches; width over all, 48 inches; length over all, 9 feet 6 inches; height above rail, 31 inches; weight, 7,500 pounds.

The current is furnished by a General Electric D 62, 75-h. p. generator, driven by a Harrisburg Ideal 80-h. p. engine.

The maximum load which these locomotives have been called upon to handle is 32 loaded mine wagons, each weighing 3,200 pounds, and the way has at one part a 3 per cent. grade. The daily haul of these locomotives is about 650 tons.

The entire plant has been pronounced eminently satisfactory, the locomotives having shown capabilities beyond the specification or the General company's guarantee. Their presence in the mine has done away with the slow-going, limited mule, and induced great economy. The small height of the machines above the rail level allows them to go into places impossible to any mule, and their ease of control and operation is such as to render them invaluable.

MINE HAULAGE LOCOMOTIVE.

Davis' Wiring Tables.

In the 500-volt table of "Davis Standard Tables for Electric Wiremen," the amperes at the head of the columns should be doubled, reading 4, 8, 12, 16, etc., instead of 2, 4, 6, 8, etc., as at present. This correction will be made in all copies hereafter sent out.

Financial Intelligence.

The Electrical Stock Market.

NEW YORK, April 9, 1894.

SECOND ANNUAL REPORT OF THE GENERAL ELECTRIC COMPANY.—The second annual report to the stockholders was presented by President C. A. Coffin at the meeting at Schenectady, N. Y., on April 2, 1894, and is as follows:

Before considering the present condition of your company, your directors deem it proper to revert to its situation a year ago. It is believed that by so doing, a clearer statement of the existing condition of your company can be had.

Your company represents a practical union of the Edison Electric Light Company, the Edison General Electric Company, the Thomson-Houston Electric Company and the Thomson-Houston International Electric Company.

To acquire these companies, your company issued the following securities (except as to $100,000 of its common stock, which was issued for cash):

Common stock	$30,459,700
Preferred stock	4,251,900
	$34,711,600
Subsequently it sold for cash its 5 per cent. debenture bonds amounting to	10,000,000
Total	$44,711,600

Of this amount $8,159,264.02 was shown in the last report as representing the cost to the General Electric Company of the Edison and Thomson-Houston patents and contract rights, and your interest in the patents of the Brush, Fort Wayne and other allied companies.

On Jan. 31, 1893, your other assets were examined and valued, and a report on the condition of your company was made to the stockholders at their annual meeting in April last. This examination was conducted under rigid instructions from your board of directors, that material on hand, stocks, bonds, customers' notes and accounts, etc., should be carefully scrutinized, and should be valued on a most conservative basis. The complex organization then existing (referred to further on in this report), and the fact that the amalgamation of the various interests represented by your company had been so recent, made the task an especially difficut one at that, but the statement made by those directly responsible to the board was, that the instructions of the directors had been strictly carried out.

Your company had inherited stocks of manufactured goods in the principal cities in which district offices were located, from Boston in the East, and Atlanta in the South, to San Francisco and Portland in the West. Notes and accounts receivable, stocks, bonds and other assets were similarly distributed. Each district office had exclusive charge of, and was presumably familiar with, the value of its own assets, and was largely independent of the general office. This defective system, since abolished, rendered it exceedingly difficult to arrive at correct conclusions, and notwithstanding the efforts of the officers, it led to grave mistakes in the estimates of value of accounts, securities and inventories of merchandise.

The Edison company, to a small extent, and the Thomson-Houston company (the organization of which was mainly adopted by your company), to a greater extent had been in the habit of doing more or less exploiting work, resulting in the acquisition of stocks and bonds of local lighting and railway companies. The Thomson-Houston company had generally been very successful in marketing these securities at profitable figures. By the facilities which it had thus been able to afford to local enterprises, it was enabled to expand its business. Your company at the time of its organization assumed a large number of such transactions, which were in progress or contracted for. The general policy of your board, however, since the organization of your company, has been to curtail transactions involving the acceptance of stocks or bonds for anything other than license rights, except where for some special reason it has been deemed advisable to accept them, as in settlement of disputed or doubtful accounts.

Among the most important transactions of the character above referred to were those with newly organized companies, and this class of business had been very extensive in the South and West. The financial and industrial collapse in these sections in the spring and summer of 1893 affected your company severely, and very many accounts, notes and investments, assumed as good a year ago, must now be recognized as of diminished value. The same is especially true as to the Northwest, where your company's output was sold through the Northwest General Electric Company, formerly known as the Northwest Thomson-Houston Company.

As you are aware, the Thomson-Houston company has large interests in various construction and manufacturing companies, notably the above mentioned Northwest company, the Fort Wayne Electric Company, the Brush Electric Company and others, the whole standing on its books at about $5,500,000. At the time of the last annual report, statements were obtained from the officers of such companies, and it was estimated that something less than one-half of this investment was represented by patent rights, and something over one-half by other assets. Unknown to your board of directors, some of these companies became unduly expanded during the winter and spring of 1892-3, and the stringency which began in April and culminated last autumn, caused them to suffer greatly. Your directors have reduced your entire holdings of Fort Wayne and Northwest stocks to a valuation of $1 each, exclusive of the amount carried in patents.

After protracted negotiations, the Northwest company has been put in liquidation, and the territory controlled by it has reverted to your contracted.

It is needless to say that the past year has been a most trying one to all corporations. It has been especially so to companies like your own, dealing with local enterprises situated in all parts of the United States, and largely dependent on normal conditions for their success and development. During the summer of 1893 even old and strong customers were obliged to ask for leniency in paying their accounts and notes. Under these circumstances your company found itself with its own obligations to meet, but unable at that time to collect the money with which to meet them. The difficulties thus presented were carefully considered by your board, and were met by selling to a syndicate certain of the company's assets, consisting of claims against, and stocks and bonds of, local lighting and railway companies, the same being of a class of which your company sold several million dollars in 1892, and which your directors, in their last report, said they intended to continue to sell from time to time as heretofore "through ordinary channels." The channels through which your company usually made such sales having become unavailable, owing to the panic, your directors adopted a plan used on several occasions in the earlier days of the Thomson-Houston Company, and made the sale of assets above described to a syndicate which paid over $4,000,000 in cash. Although the transaction involved a large shrinkage from book valuations, the sale was at a price high under the conditions then prevailing. Few of the securities sold were listed on any exchange or commonly dealt in, and it was not possible to effect a ready sale, except in bulk, to a syndicate. These assets were placed in a trust known as "The Street Railway and Illuminating Properties." After the financial stringency had subsided, the right to subscribe to them was offered to the stockholders of your company.

The depreciation in value of the assets thus sold applies equally to those still on hand. Holders of stocks and bonds of almost every kind find them quoted to-day much lower than a year ago, and this company, as a holder of electrical stocks and bonds, is no exception to the rule. In fact, the shrinkage in values in electrical securities has been greater than in most others. The last year has been characterized by shrinkage in every direction, and your company has suffered severely from it.

Since the combination of the Edison and Thomson-Houston companies, in 1892, your directors have been earnestly endeavoring to simplify your organization. As a result of the union, your company suddenly came into control of some twenty companies, all engaged in active exploitations and having their own separate boards of directors and independent managements, with separate accounts and liabilities. At first your board had little success in its efforts to centralize and simplify the organization, but the events of the last summer emphasized the necessity of radical changes so unmistakably as to secure the co-operation necessary to effect the desired results. The "district offices" are practically abolished, except as mere sales offices. The business management of the company has been concentrated at its principal office at Schenectady, and its whole organization has been greatly simplified. All accounts are kept there, and all sales and credits are supervised there. So far as practicable, your manufacturing business has been, and will be, concentrated at Schenectady; and the operations of its other factories are now directed from there. During the short time since this change was effected, many advantages have accrued to the company from this concentration of the selling, accounting, manufacturing and engineering departments of the company.

Besides the shrinkage in the inventory value of the securities of local and other companies hereinbefore mentioned, as sold and on hand, there is a shrinkage in the inventory value of apparatus and material at factories and storerooms, and of machinery and fixtures at storerooms amounting to $2,382,012.94. This shrinkage is partly due to the fall in value of material manufactured and in process of manufacture, and partly to the development in electrical science, which has been so great during the last year or two that apparatus which at the time of the last inventory was looked upon as commercial, has been superseded by entirely new and superior types. Consequently the older apparatus has become unsalable, or of slow sale, and most of it has been reduced to "scrap" value, and the remainder to much less than cost.

FINANCES.

On July 31, 1893, the direct and indirect obligations of the company (including the Edison, Thomson-Houston and International companies), exclusive of the debenture bonds, were:

Direct obligations:		
Notes payable	$4,446,000	
Dividend	609,000	
Accounts payable and accrued interest	1,579,000	
Total direct obligations	$6,634,000	
Less cash on hand	1,294,000	
Net amount of direct obligations	$5,340,000	
Indirect obligations:		
Paper discounted under endorsement	$3,394,000	
Net amount of direct and indirect obligations, July 31, 1893		$8,734,000
On Jan. 31, 1894, these matters stood as follows:		
Direct obligations:		
Notes payable	$744,000	
Accounts payable, accrued interest, etc	406,000	
Total direct obligations	$1,150,000	
Less cash on hand	591,000	
Net amount of direct obligations	$559,000	
Indirect obligations:		
Paper discounted under endorsement, guarantee, etc	$1,425,000	
Net amount of direct and indirect obligations, Jan. 31, 1894		$1,984,000
Reduction of debt in six months		$6,750,000
Of which there was received from street railway and illuminating properties		$4,050,000
Reduction of debt from other sources (principally collections of notes and accounts receivable)		$2,700,000

This reduction does not disclose all the improvement of the last six months. The indirect obligations of the company, arising from its endorsement of discounted notes receivable, were six months ago almost as embarrassing as its direct debt, as the larger part of them had to be provided for by your company at maturity, their makers being unable to take care of them. To-day no paper is under discount, except such as it is believed will be paid by the makers; consequently the indirect obligations of the company are nominal rather than real.

At the date of this report, the direct obligations have been reduced to about $750,000, which are partly offset by about $400,000 cash on hand, and the paper under discount is reduced to about $750,000.

In addition to the above, there are still outstanding some important guarantees given two years ago by the Thomson-Houston company to the United States Securities Company, whereby in one form and another it is claimed that the Thomson-Houston company (and, practically, the General Electric Company) is bound to take back from the Securities company certain bonds of local companies at a valuation of $702,000. This liability has been in part arranged for by substitution of other securities, and it is not thought that such guarantees will involve any considerable cash outlay, although their ultimate adjustment may result in some loss.

Your directors believe that the notes and accounts receivable, and such stocks, bonds, etc., as it is undesirable for the company to hold permanently, can, with some delay and patience, be collected and marketed to such an extent as shall not only liquidate the small amount of remaining obligations, but shall also supply all necessary working capital. Earnest attention is being given to the sale of these assets.

While the liquidation of the debt has been going on, the company has also readjusted its basis for sales, either to cash or to short credits to desirable customers. In view of the extreme depression and the uncertainty as to the early future, your directors have not felt justified in any other course than that of adhering strictly to sales on this basis. It is believed that your company has lost little legitimate business in consequence of its curtailment of credit to customers. It intends to confine its business to this basis, and to accept smaller profits.

Your directors do not believe that it will be possible for some time to come to do as large a business as was done by the company prior to the panic, although a gradual improvement has been apparent during the last two months. The street railway business, which to a considerable extent was formerly done through syndicates and promoters, many of whom have become embarrassed, promises to be smaller than during the previous year. Arc lighting business is also reduced, largely because of the inability of local companies to secure capital with which to extend their business for the purpose of carrying out municipal contracts. The business of the company, with respect to incandescent lighting, which is, to a great degree, performed by strong and conservatively managed local companies, is in a more healthy condition, and has not suffered so severely. The business in plants for the distribution of electrical power is promising, and many important installations are in progress. The application of electricity to various mining purposes, such as hauling, hoisting, drilling, etc., is increasing. The future in this respect is promising. The increase in the number of local lighting and railway companies is shown by the following table:

	Feb. 1, 1892.	1893.	1894.
Total number of local companies operating incandescent and arc lights	1,158	1,277	1,479
Total number of railway companies	214	435	541

LICENSEE COMPANIES.

The substantial and permanent character of the business of local illuminating companies, distributing light and power by the methods and protected by the patents controlled by your company, is more widely recognized year by year. The true interests of this company lie in advancing the interests of its licensees in every possible way, and to this end prices of apparatus have been reduced during the past year, and the licensees will continue to receive, from time to time, the benefit of further reductions in cost of manufacture.

PATENTS.

Substantial progress has been made during the year in the prosecution of suits against infringers of many of the more important patents belonging to the company. The "feeder and main" patent, which is of fundamental importance, particularly for low tension lighting plants, has been sustained by the Circuit Court for the District of New Jersey.

The litigation on the incandescent lamp patent has been generally successful, although the most strenuous efforts have been made by infringers to defeat the patent or to devise some form of lamp that would be outside of it. In two instances we have met with reverses in this litigation, which have proved to be comparatively unimportant. In these instances we are advised there is a strong probability that we shall ultimately prevail. The efforts to evade the patent by so-called "lamp repairs," and by injecting a harmless amount of inert gas into the bulb, have been defeated.

Our counsel are hopeful that the courts will so construe the law that the lamp patent will run for the full term for which it was granted, in spite of the fact that the situation is somewhat complicated by foreign patents. If we succeed in maintaining this position, the patent will be of substantial value to the company for some years.

Owing to the inevitable delays of litigation, the important cases on patents for railway work, upon which we place great reliance, have not yet come to hearing. It is expected that many of these cases will be determined during the coming year.

No final decision has been rendered against the company on any patent. During the past year several such suits against the company have been decided in its favor, notably the suit on the patent for the hydro-carbon treatment of the filament of incandescent lamps, which has been disposed of in our favor by the decision of the United States Circuit Court of Appeals.

Upon the whole, the patent situation seems to be promising, and we believe that at the next annual meeting we shall be in a position to report substantial progress.

All expenditures for patents and patent rights during the year under review, and all expenses of patent litigation, have been charged to operating expenses.

STATEMENT OF ACCOUNTS.

There are submitted herewith:

Consolidated balance sheet of the General Electric Company, includes the underlying companies, viz.: The Edison Electric Light Company, the Edison General Electric Company, the Thomson-Houston Electric Company and the Thomson-Houston International Electric Company, as of Jan. 31, 1894:

Statement of profit and loss account as of same date.

List of stocks and bonds owned.

In explanation of the items in the balance sheet, your directors deem it proper to state as follows:

Manufacturing Plants.

In the last annual reports, pages 8 and 9, the Edison General Electric Company's plants at Schenectady and Harrison were carried at	$2,677,548.09
The Thomson-Houston company's plant at Lynn was carried at	1,240,066.77
In addition there were sundry small machines and tools included in the report in the Lynn factory's inventory account	40,913.35
Making the total manufacturing plants on Jan. 31, 1893	$3,958,528.21

During the year the sum of $884,659.11 has been expended in additions to the manufacturing plants and their equipment. On the other hand, the sum of $902,058.34 has been written off the profit and loss for depreciation, leaving the cost of such plants on the books $3,941,128.98, which is $17,399.23 less than they were carried at Jan. 31, 1893.

Stocks and Bonds of Manufacturing Companies.

This is an investment account in the stocks and bonds of various companies, and it is believed to be conservatively valued. Details will be found in Schedule A.

Stocks and Bonds of Local Companies.

A list of such stocks and bonds owned by the company is annexed hereto (Schedules B and C), and, as will be noticed in the profit and loss statement, a great shrinkage has been made in

the valuation of the securities shown in said schedules, in order to reduce their book value to what is believed to be within their real value.

Inventory and Consignments.

The supplies of raw material, manufactured goods and goods in course of manufacture, at the factories, have been carefully inventoried, item by item, and a reduction of $1,217,142.81 has been made from the sum at which they were previously carried. The supplies of finished apparatus in the different local salesrooms of the company and on consignment have been dealt with in the same manner, and the sum of $940,365.03 has been charged off on them.

Notes and Accounts.

As to the notes and accounts receivable (of over 6,000 customers) there is, in many instances, among those whose duty it is to pass upon their value, a wide difference of opinion. They have been classified item by item, and your board has taken them at the lowest suggested valuation. The amount includes $2,531,609.88 due by the Fort Wayne, Northwest and othed allied interests.

Work in Progress.

This represents the amount charged up against installations in progress, and is believed to be valued safely.

ORGANIZATION.

Numerous vacancies, principally due to resignations, have occurred in your official organization during the year, and have been filled as indicated in the list of officers, which accompanies this report. The selections to fill such vacancies have, in every instance, been made in recognition of general merit and of fitness especially displayed during the strain of the last eight months.

During the year, the entire internal organization of your company has been readjusted, and the number of departments has been reduced. This has resulted in a large saving of expense and increased efficiency. Your board now feels that the personnel of your organization is adjusted in a manner where few changes among subordinates are likely to be made in the early future, and a general appreciation of this fact will lead to more efficient work than was possible during the transition period.

C. A. COFFIN.

CONSOLIDATED BALANCE SHEET.*—JAN. 31, 1894.

Assets.

Patents and franchises		$8,159,264.02
Manufacturing plants		3,941,128.98
Real estate (not including factories):		
Edison Building, N. Y. City	$412,356.13	
Less mortgage thereon	200,000.00	
	212,356.13	
Other real estate	111,329.10	
		323,685.23
Stocks of manufacturing co.'s (Schedule A)	2,767,470.58	
Stocks and bonds of local co.'s (Schedules B and C)	2,723,493.17	
		5,490,963.75
Cash	591,143.88	
Notes and accounts receivable (face value $14,984,697.42)	8,934,159.75	
		9,525,303.63
Inventories:		
At factories	3,349,042.94	
At sales offices (including consignments)	1,485,749.68	
		4,834,792.62
Work in progress		1,198,343.58
Profit and loss		12,454,967.42
		$45,928,449.23

Liabilities.

Capital stock:		
Common	$30,459,700.00	
Preferred	4,251,900.00	
		$34,711,600.00
Five per cent. gold coupon debenture bonds		10,000,000.00
Mortgages		26,200.00
Accrued interest on debenture bonds	83,333.32	
Notes payable	744,341.31	
Accounts payable	323,084.82	
		1,150,759.45
Sundry credits		39,889.78
		$45,928,449.23

CONSOLIDATED STATEMENT OF PROFIT AND LOSS.*—JAN. 31, 1894.

Dr.

Interest on debenture bonds	$499,893.62	
Dividends	1,655,150.50	
Taxes	195,457.31	
World's Fair expenses	241,877.52	
		$2,592,378.95
Amounts now charged off:		
On patents		733,870.75
On notes and accounts receivable and on stocks and bonds, sold and on hand		10,444,318.78
On manufacturing plants		902,058.34
On inventories and consignments		2,157,507.84
On machinery, tools, instruments and fixtures—other than at factory		224,505.10
On sundry losses		125,205.31
		$17,179,845.07

Cr.

General Electric Company's surplus, Jan. 31, 1893	$1,024,954.59
Manufacturing and selling profits after deducting general expenses	3,189,884.37
Dividends and interest on stock and bonds owned	433,293.06
Interest, discount and exchange	76,745.63
Debit balance carried forward	12,454,967.42
	$17,179,845.07

J. P. ORD, Second Vice President.

*General Electric Company, Edison Electric Light Company, Edison General Electric Company, Thomson-Houston Electric Company and Thomson-Houston International Electric Company.

GENERAL ELECTRIC has been the subject of a vast deal of comment. The directors made public this week the result of operations for the year ending Jan. 31, 1894, and the showing presented is as bad as was expected. The stock declined several points on the first announcement of the annual report, but there has been a sharp recovery on the further appreciation of the fact that the bad results had been discounted weeks ago, and the change of quotations for the week is hardly appreciable. The most gratifying feature of the report is the frankness with which the management lays before the security holders the condition of the property. There has been no attempt to cloak over any of the distressing details of mismanagement and misfortune that have brought the General Electric Company to its present sad condition. The upshot of the year's operation is the conversion of a surplus of $1,024,954, reported on Jan. 31, 1893, into a profit and loss debit a year later of $12,454,967, this amount representing the impairment of the capital. It is impossible to accurately or fully present here all the features of the report, so full is it of matters of the highest import to the security holders. An analysis of the income account shows that the net manufacturing and selling profits were $3,189,884, which is less than the profits for the eight months ending Jan. 31, 1893. The total net receipts were $3,699,923, while the disbursements for interest and dividend payments, taxes and World's Fair expenses were $2,592,379, leaving an apparent balance of $1,107,554. The dividends paid included one semi-annual distribution of 3½ per cent. on the preferred stock, and two quarterly payments of 2 per cent. each on the common stock. The report of the company notes at the start that grave mistakes arose in the beginning, owing to the complicated organization of the company, in the estimates of the values of accounts, securities and inventories of merchandise submitted at the last annual meeting. These mistakes arose through the multiplicity of district offices, which have since been practically abolished, except as mere sales offices. The management has also curtailed the old time practice of accepting stocks and bonds for anything but license rights. The report's most interesting details relate to the scaling down of assets and the reduction of debt. These are matters of the most vital value to the company's solvency, and the stockholders are made acquainted at full length with the condition of affairs. As illustrating the working down of assets, it is well to quote a paragraph from the report: "The Thomson-Houston company had large interests in various companies, notably the Northwest company, Fort Wayne Electric Company, the Brush Electric Company and others, the whole standing on the books at about $5,500,000. Unknown to your board of directors, some of the companies became unduly expanded during the winter and spring of 1892-93, and the stringency, which began in April and culminated last autumn, caused them to suffer greatly. Your directors have reduced your entire holdings of Fort Wayne and Northwest stocks to a valuation of $1 each, exclusive of the amount carried in patents." The depreciation in value of the assets sold to "The Street Railway and Illuminating Properties," as well as those on hand, is treated in detail in the report above, the result being that $14,587,466 stands charged off on the profit and loss account. The course of the floating debt was the important factor bearing on the company's solvency during last year's trying periods, and there is interest in the history of its funding and reduction. On Jan. 31, 1893, the direct obligations of the company (including the Edison, Thomson-Houston and International companies), exclusive of the debenture bonds, were $4,782,763 net, after deducting $3,871,034 cash on hand from the total of $8,653,797. On July 31, 1893, the account of direct obligations, as stated in the report, stood: Notes payable, $4,446,000; dividend, $609,000; accounts payable and accrued interest, $1,579,000; total, $6,634,000; less cash on hand, $1,294,000; net amount of $5,340,000. Evidently the company had paid out its cash and reduced its indebtedness accordingly, the increase of net debt being practically the amount of the August dividend—the last paid on the common stock. On Jan. 31, 1894, these mat-

ters stood as follows: Notes payable, $774,000; accounts payable, accrued interest, etc., $406,000; total direct obligations, $1,150,000; less cash on hand, $591,000; net amount of direct obligations, $559,000. The floating debt was thus reduced in six months $4,781,000, of which $4,050,000 were derived from the sale of securities to the Street Railway and Illuminating Properties and $731,000 from the collection of notes and accounts receivable. The indirect obligations, arising from the endorsement of discounted notes receivable are now $1,425,000, a reduction during six months of $1,969,000. It is impossible to make a comparison of the balance sheet just issued with the one presented a year ago. In the first place the 1892 balance sheet was for only eight months, while the 1893 figures are for twelve months. But the change of items is so radical as to prevent an itemized comparison. Thus "Patents and Franchises" and "Manufacturing Plants," valued respectively at $8,159,265 and $3,941,129, do not appear at all in last year's balance sheet, while "Stocks of Underlying Companies," which stood in last year's statement at over $18,000,000, do not appear this year. There are other equally important changes. The valuation of $8,159,265 put on patents and franchises is the subject of much criticism, most experts declaring that, by reason of ability of the company's competitors to do business under other patents, these figures are much too high. Again, business, to judge from the profits reputed, must have been done often at a loss. Only a little over 8 per cent. was earned on the two classes of stock, and this is a very small margin of profit for a big manufacturing concern to operate on. Much speculation is indulged in as to the book value of General Electric. This is mere guesswork, as the value of such a stock as General Electric depends a good deal more on its earning capacity than on the assets. If the company can, in the worst year on record, earn over $2,250,000 above fixed charges, it ought to soon reach a period when it can again distribute profits among stockholders. The facts are now known, and, as the General Electric Company is now financially easy, its prospects are much improved. The annual meeting is next Tuesday, and, as outlined in these columns last week, the present management is likely to hold over. Apropos of reports concerning new business, it was learned to-day that since Jan. 1 the General Electric Company has done a cash business of over $350,000, or about $23,000 a week. This last week alone the railway department closed a contract for $116,000 cash.

WESTINGHOUSE ELECTRIC stocks have had another spurt on the publication of figures relating to the annual report. It is stated that it will show net earnings above all expenses, dividends and charges of $1,790,000. This is an increase over the previous year of $630,000. The floating debt has been reduced since Jan. 15 from $1,140,000 to $750,000. The surplus of the company will show an amount of quick assets equal to the sum at which the patents of the company are carried on the books.

EDISON ELECTRIC ILLUMINATING, of New York, 5 per cent. first mortgage gold bonds have had a substantial rise this week. The syndicate, including Drexel, Morgan & Co., A. A. H. Boissevain and others that recently started to market a block of $750,000 of the authorized issue of these bonds, has closed out the entire amount, and the syndicate has disbanded. These bonds are convertible till July, 1895, into stock now paying 6 per cent. dividends, and are redeemable at 110 after 1900. After 75 per cent. of the issue is converted, the company can require the conversion of the remainder. It is stated that the earnings of the company for the quarter ended March 31 are the largest in the history of that company for that quarter. The usual quarterly dividend of 1½ per cent. will be declared next week.

WESTERN UNION TELEGRAPH stock continues strong. There is a tremendous short interest in the stock, and if they are once forced starting to cover, the prediction of the bulls that 90 will be soon crossed, is likely of fulfillment. The bears still talk of decreased earnings, and will not show 5 per cent. earned on the stock this year. They even say that the dividend will be passed during 1894. On the other hand, Mr. George Gould advises some of his best personal friends to go long of "Telegraph" and to buy it on every opportunity. All the selling down so far has failed to dislodge long holdings.

THE STREET RAILWAY AND ILLUMINATING PROPERTIES has again retired 2,050 shares of the preferred stock, under its latest call, at an average price of 97.54. Since last summer the company has retired 8,664 shares of its 45,000 shares of preferred stock—500 shares at an average price of $82.94, 843 shares at $82.90, 1,320 shares at $83.28, 2,354 shares at $84.94, 1,597 shares at $93.92 and 2,050 shares at $97.54. Par is 100, and the shares cost the syndicate subscribers 90, with a bonus of common stock to the same amount as the preferred. This common stock is now quoted at 20 bid, 21 asked. The trustees propose to liquidate all the property in their possession as the opportunity offers, and after the $4,500,000 preferred stock has all been purchased or drawn and cancelled, further receipts will be divided to the common stock as fast as received. The sale last summer to this company by the General Electric Company of $12,000,000 in order to raise $4,050,000 with which to meet floating and avoid bankruptcy, is treated upon in the annual report of the General Electric Company with some detail. The success of the trustees in cancelling preferred makes it a pity that the General Electric Company should have had to so sacrifice its valuable treasury assets.

AMERICAN BELL TELEPHONE quotations continue to be benefited by the splendid showing of the annual statement made public last week. The reports of new competition seem to have lost all effect.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	20	35
Detroit Electrical Works	10	2	3
Cleveland General Electric Co	—	85	90
East River Electric Light	100	—	95
Electric Con. & Supply Co., pref	15	15	16
" " " com	15	15	17½
Edison Electric Ill., New York	100	102½	103½
" " " 1sts	—	107¼	107½
Edison Electric Ill., Brooklyn	100	103	104*
" " " Boston	100	115	120
" " " Chicago	100	125	130
" " " Philadelphia	100	130	132
Edison Electric Light of Europe	—	—	3
" Bonds	—	80	85
" Ore Milling	—	10	11
Fort Wayne Electric	—	4½	6½
General Electric Company	100	41¾	42
" " deb. 5's	—	85	86
Interior Conduit and Ins. Co	100	35	50
Mount Morris Electric	—	—	65
Westinghouse Consolidated	50	33	34
" " " pref.	50	49¾	50
Western Union Telegraph	—	85¼	85⅝
American Bell Telephone	—	188	189

*Ex. dividend.

New Incorporations.

THE ELECTRIC BELT AND APPLIANCE COMPANY, Chicago, Ill., capital stock $500,000, has been formed to manufacture and deal in electric belts, etc. J. H. Fitch, H. L. Dietz and S. H. Trade are interested.

THE CITIZENS' ELECTRIC LIGHT AND POWER COMPANY, Hudson, N. Y., capital stock $10,000, has been formed to do an electric light, heat and power business. S. D. Lake, A. J. Rowles and E. J. Hodge, of Hudson, are interested.

THE PLANTE COMPANY, Jersey City, N. J., capital stock $1,000,000, has been formed to sell, maintain and construct electrical power plants, etc. R. McA. Lloyd, H. G. Ward, New York, and L. McKim Garrison, Orange, N. J., are the promoters.

THE HOUTZDALE AND SUBURBAN ELECTRIC RAILWAY, Hazleton, Pa., capital stock $100,000, has been formed to build and operate an electric railway in Clearfield County. The incorporators are A. Markle, J. E. Giles and E. S. Doud, of that town.

SCOTT & CO., New York City, capital stock $3,000, has been formed to manufacture electrical apparatus. C. P. Scott, 189 West 134th street; B. F. Hamilton, 227 West 135th street, and F. W. Harrington, 204 W. 133d street, New York, are the incorporators.

THE DEAN ELECTRIC MANUFACTURING AND SUPPLY COMPANY, Des Moines, Iowa, capital stock $50,000, has been formed to buy, sell and manufacture electrical and mechanical devices. J. E. Brunner and W. S. Bales, of Des Moines, are interested.

THE SACHS ELECTRIC COMPANY, New York, capital stock $20,000, has been formed to manufacture and deal in electrical appliances. T. L. Peter, 30 Pine street; C. T. Haviland, 29 Broadway, and Francis Forbes, 137 Broadway, New York, are the promoters.

THE BANSOR ELECTRIC LIGHT, HEAT AND POWER COMPANY, Bansor, Pa., capital stock $30,000, has been formed to generate electricity and steam, and to supply light, heat and power, etc. D. Ruddleson, Milton Flory and B. F. Miller are the promoters.

THE BLUESTONE ELECTRIC LIGHT COMPANY, Coopers, W. Va., maximum capital stock $50,000, has been formed to operate and maintain electric light and power plants, etc. The promoters are J. Cooper, Coopers; B. Moore and J. P. Bowen, Bremwell, W. Va.

THE PHILIPSBURG AND SUBURBAN ELECTRIC RAILWAY, Hazleton, Pa., capital stock $100,000, has been formed to construct and operate an electric railway in Clearfield and Centre counties. A. Markle, J. E. Giles and E. S. Doud, of Hazleton, are the promoters.

THE AKRON STREET RAILWAY COMPANY, Akron, Ohio, capital stock $700,000, has been formed to build and operate railways and to supply electricity for light, heat and power. J. F. Seiberling, I. M. Miller, W. H. Carter, L. C. Miles and F. A. Seiberling are interested.

THE IDEAL LIGHT AND POWER COMPANY, Chicago, Ill., capital stock $10,000, has been formed to build and maintain an electric light plant for generating and supplying electricity for light and power, etc. W. E. McKee, J. H. Garrett and J. B. Morgan are the promoters.

THE FOX RIVER ELECTRIC RAILWAY COMPANY, Green Bay, Wis., capital stock $100,000, has been formed to build and operate an electric railway between Green Bay, Howard, De Pere and Allouez, Brown County, Wis. J. H. Elmon, A. Spuhler and F. A. Hallman are interested parties.

THE LIGHT, HEAT AND POWER COMPANY OF FISHKILL AND MATTEAWAN, Fishkill Landing, N. Y., capital stock $40,000, has been formed to supply electricity and gas. W. D.

Haven, Trenton, N. J.; W. R. Scofield and W. W. Wilkworth, Fishkill Landing, N. Y., are the promoters.

THE DONLON AND MILLER MANUFACTURING COMPANY, Brooklyn, N. Y., capital stock $50,000, has been formed to manufacture electric and gas fixtures. John Donlon, 107 Adams street; A. S. Miller, 212 Clinton street, and John F. Miller, 212 Clinton street, Brooklyn, are interested.

THE INTERNATIONAL SUPPLY MANUFACTURING COMPANY, Detroit, Mich., capital stock $500,000, has been formed to manufacture and deal in electrical machinery and supplies. A. H. Davis, C. G. Willoughby, O. W. Hanna, W. M. Durand and H. Jones, Detroit, Mich., are the organizers.

THE ROYAL ARC COMPANY, Citizens' Bank Building, Elizabeth, N. J., capital stock $3,000,000, has been formed to manufacture and deal in apparatus for producing electric light. A. Bellamy, A. H. Patterson, W. W. Dixon, New York, and F. C. Marsh, Elizabeth, N. J., are the promoters.

THE OKLAHOMA GAS AND ELECTRIC COMPANY, Denver, Col., capital stock $100,000, has been formed to construct and maintain a plant for furnishing electric light to Oklahoma. S. S. Price, J. G. Fakes, W. H. Barr, F. E. Workman, Oklahoma City, and J. W. Rice, Salina, Kan., are the promoters.

THE ELECTRIC BOAT COMPANY, Chicago, Ill., capital stock $100,000, has been formed to manufacture and sell Salisbury electric motors and other electrical boat propelling apparatus, primary and storage batteries, etc. C. D. Wright, L. D. Wright and John Templeton are interested.

THE MUTUAL TELEPHONE EXCHANGE CONSTRUCTION COMPANY, Rahway, N. J., capital stock $50,000, has been formed to construct and maintain overland, underground and submarine telegraph and telephone lines; also exchanges, and to manufacture and sell electrical apparatus and appliances of all kinds. G. Crawford, W. A. Hammett, H. W. Pope, New York; J. M. Shaw, West Brighton, S. I., and D. S. Robeson, Rahway, N. J., are the incorporators.

THE FAIRFIELD COPPER COMPANY, Jersey City, N. J., capital stock $5,000, has been formed to carry on the business of bessemerizing and refining copper and other metals by means of electricity, etc. T. K. Egbert, Pattenberg, N. J.; G. Lowther, Riverside, Conn.; H. Hanson, L. J. Merkel, New York City; J. H. Cameron, Fall River, Mass; E. I. Smith, Ansonia, Conn; O. G. Jennings, Fairfield, Conn., and Charles H. Brush, Brooklyn, N. Y., are the organizers.

Special Correspondence.

New York Notes.

OFFICE OF THE ELECTRICAL WORLD,
41 Park Row NEW YORK, April 9 1894.

THE NEW YORK BOARD OF ELECTRICAL CONTROL has had its term extended three years from Nov. 1, 1894.

THE FIBRE CONDUIT COMPANY, now at 45 Broadway, New York, will move into new offices in the Home Life Insurance Company Building, 257 Broadway, on May 1.

THE KNAPP ELECTRIC AND NOVELTY COMPANY, 34 Warren street, reports a larger inquiry for battery motors than last year, and expects a substantial increase in sales as soon as

MR. M. W. DEWEY, inventor of the Dewey electric car heater, and now consulting engineer of the American Electric Heating Company, of Boston, Mass., was in town for a few days last week.

MR. C. T. SNEDEKOR, inventor of the celebrated brand of Salamander wire, sailed for Europe April 4, on the Teutonic, on business in connection with the various European agencies of his wire.

NEFTEL, O'CONNOR & CO., INC., have closed contracts with the Union Railway Company for building its 135th street trolley road, the first to be built in New York City, and for the Mount Vernon lines.

MR. W. H. FLEMING has severed his connection with the International Trading and Electric Company. The Manhattan General Construction Company of 50 Broadway, New York, and 753 Monadnock Building, Chicago, has made arrangements with him to act as selling agents for his patent woven wire gauze dynamo brush.

H. B. COHO & CO. report that they intend, in addition to handling the Mather Company's apparatus, to make a specialty of small plants for country residences. There seems to be a great demand for plants, including gas engines, storage batteries and dynamos, and we feel that Messrs. Coho & Co. should have a great success in this line.

THE BUCKEYE ENGINE COMPANY on April 1 will remove its office from 18 Cortlandt street to larger and more commodious offices at 39 and 41 Cortlandt street. The Buckeye company calls attention to the fact that in addition to its regular line of plain, tandem compound, cross compound and triple expansion horizontal engines, it now makes vertical compound engines for electric light and railway service ranging from 150 h. p. to 1,200 h. p. and over, and specially adapted for direct connecting dynamos.

MESSRS. J. JONES & SON have bought from the receiver the entire stock on hand of the late corporation of Alexander, Barney & Chapin, and will move their offices from 39 Vesey street to the quarters now occupied by the A, B, C Company, at 67 Cortlandt street. It is understood that by paying spot cash Messrs. Jones & Son got the stock at an exceedingly low price. As will be noticed from an announcement in last week's issue, the firm offers the goods to the trade at a discount of from 25 to 50 per cent. below market price, and offers to send upon application a printed list of the stock on hand. Messrs. J. Jones & Son are to be congratulated on their enterprise in this matter. Mr. Jones was for many years a member of the firm of Pearce & Jones, and he and his son, Mr. James Jones, Jr., comprise the firm of J. Jones & Son.

THE BROOKLYN BOARD OF ALDERMEN has approved of the report of the lamps and gas committee, giving the contracts for furnishing the lighting of the streets to the Edison, Citizens' and Municipal companies. By the terms of the resolution adopted the Edison company will soon be in a position to control a major part of the street lighting. Hitherto this company has been out in the cold, so far as city patronage was concerned, and the two other companies, which are controlled by Democratic politicians, had virtually a monopoly of the business. The lamps and gas committee also reported in favor of giving a franchise to the State Electric Light and Power Company, which had been vainly seeking this privilege from the two preceding boards. Alderman Cohn said that President Noah L. Cocheu had been credited with making statements seriously reflecting on the integrity and good faith of some members of the board, and he suggested that before the franchise was granted an investigation of the charges should be made. After some discussion the president of the board was directed to appoint a committee of seven to make an investigation.

THE MERCANTILE ELECTRIC COMPANY has filed a certificate of incorporation. Its purpose is to construct and maintain lines of telegraph and telephone, and its line is to run from 120 Broadway, through Broadway to the Battery, through Pine street to Nassau, to William street, through Nassau to Broad street to the East River, through William street to Hanover square, through Wall street to Pearl street, through Pearl street to Cedar street, through Cedar street to Broadway, connecting with the United States Sub-Treasury and various other buildings, with a central office at 120 Broadway, and through such other streets of the city as the needs of the business may require. The capital stock of the company is $5,000. The directors of the company are Henry A. Huribut, Lyman Rhoades, Henry S. Terbell, George W. Phillips, Louis Fitzgerald, Thomas D. Jordan and William Giblin. Mr. Lyman Rhoades says that the incorporators of the company did not mean that it was going to enter business as a competitor of the Metropolitan Telephone and Telegraph Company. The reason that directors of the Equitable Assurance Society appeared as incorporators was simply that these gentlemen were associated with him in other business ventures. The Mercantile Electric Company has long done a private business, although not incorporated, Mr. Rhoades added, and it has used overhead wires mainly. It is incorporated now because it desires to go into the subways, and cannot do so without incorporating as an electric company. It will do a small special business, the same as it always has, and that is all.

New England Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., April 7. 1894.

THE ELECTRIC GAS LIGHTING COMPANY, 195 Devonshire street, Boston, Mass., has been appointed New England agent for the sale of "Kerite" wires and cables.

SALAMANDER WIRE, with its remarkable fireproof qualities, continues to attract wide attention. The Boston and Maine depot, of Boston, which is said to have the largest isolated lighting plant in New England, is wired with Salamander wire.

BOSTON, MASS.—Sealed proposals will be received to May 2, at noon, by the fire commissioners of Boston, at their office on Bristol street, for furnishing the machinery of the operating room of the new central station of the fire alarm system, as per details to be had of Robert G. Fitch, chairman.

Pittsburgh Notes.

PITTSBURGH, April 7, 1804

THE ALLEGHENY AND KISKEMINETAS RAILROAD COMPANY has presented a petition to councils in Allegheny City asking for a right of way to build a railroad from Allegheny to Tarentum, a distance of 12 miles.

THE BESSEMER LIGHT, HEAT AND POWER COMPANY, of Braddock, Pa., has been chartered with a capital of $10,000. The

directors are Josiah Barrett, Allegheny; James P. McKelvy, Braddock, and Charles E. Ellis, Swissvale.

IN WASHINGTON, PA., a local telephone company has been organized to compete with the Central District and Printing Telegraph Company, and the result has already shown itself in a reduction of from $60 to $36 by the old company.

THE ELECTRIC STREET RAILWAY at Washington, Pa., has been sold by the sheriff for $10,900. The capital stock of the company was $50,000, and the cost of building the line exceeded that amount. The property will now go into other hands and will be extended. New Westinghouse machinery will be put in the power house.

AT A RECENT FIRE in Brownsville, a neighboring borough of this city, it was discovered that the horses which usually pulled the fire engine and hose carriage could not be found. To overcome the difficulty these vehicles were attached to a motor car of the Suburban electric line, with the result that the distance to the scene of the fire, two miles and a half, was covered in eight minutes. The fire was gotten under control before much damage had been done. It is now suggested to do away with the horses altogether.

MR. LEON LE PONTOIS, of the Westinghouse Electric and Manufacturing Company, gave a lecture April 4 at the Keystone Electrical College, in this city. Mr. Pontois explained to his audience the generation of current, giving practical demonstrations of the fact that whenever a conductor is moved in the magnetic field, the peculiar molecular movement, known as the electrical current, must take place. He based his statements on the theory that electricity and magnetism, like light and heat, are the results of a peculiar vibration of matter. He said that in the study of electrical phenomena, it is better to rise above the plane of mathematics into that of pure reason, for the one only shows the mechanical relation of one thing to another, whilst the reason enters into the cause of things. Mr. Pontois attempted to demonstrate that atomic vibration is a necessary consequence of the force which keeps together all celestial bodies. All dynamos are based on the principle discovered by Faraday, that electric currents are generated in a conductor by moving them in a magnetic field. Therefore, if the reason why such phenomena are produced is clearly shown, the study of all kinds of dynamos and motors becomes very simple. Mr. Pontois intends to give a series of lectures explaining in detail the construction, operation and management of electrical apparatus.

Western Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD
936 Monadnock Building CHICAGO April 7, 1894.

MR. GEORGE A. McKINLOCK, president of the Central Electric Company, has gone to Old Point Comfort, Va., for a couple of weeks' rest and recreation.

MR. W. H. SILLS, 86 Lake street, Chicago, Ill., has taken the Western agency for the sale of mica and "Micanite," manufactured by Eugene Munsell & Co., New York.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY'S factory, on Clinton street, presents a scene of unusual activity now-a-days. The company has its hands full taking care of the orders that come from all sections of the continent for its new telephone.

THE LINK-BELT MACHINERY COMPANY has recently taken a most conspicuous position in the ranks of manufacturers supplying apparatus to the electrical industry. It is now handling the Caldwell standard water tube safety boiler, the Ewart guaranteed friction clutch and their famous link-belt machinery.

THE GREAT WESTERN MANUFACTURING COMPANY reports its weekly sales of Clark wires and cables larger than ever. Its works at Duluth are crowded with orders for all kinds of electrical apparatus now on the catalogue of this enterprising firm. Manager H. K. Gillman has recently returned from a long Southern business trip.

LINCOLN & CO. is the name which now adorns the door of 934, the Monadnock. On the card handed out by Mr. Lincoln, late of Goodhue & Lincoln, the object of this new firm is stated as that of "high class electrical goods" and "manufacturers' agent." Mr. Lincoln is one of the popular young men of the West, and his future seems promising.

THE WALLACE ELECTRIC COMPANY, an announcement of which appeared in a recent issue, has completed its new catalogue, which shows that it will handle some of the best known specialties on the market. On May 1 this company will occupy a commodious store at 307 Dearborn street. Both Messrs. Wallace and Hine are very busy now-a-days.

THE INDEPENDENT ELECTRIC COMPANY, successors to the Sperry Mining Machine Company, is now meeting with deserved success in its efforts to introduce electrical machinery into mining operations. It has recently received some very flattering testimonials, and, what is more satisfactory, a number of very nice orders for apparatus of this kind.

THE METROPOLITAN ELECTRIC COMPANY seems to be about as busy as any firm in the West, and has all the business it can handle. Its lines of specialties are exceptionally well liked by central station and street railway managers, and its headquarters on Fifth avenue are thoroughly equipped to handle the enormous business that seems ever on the increase.

THE CENTRAL ELECTRIC COMPANY, which recently surprised Chicago, and pleased its many friends by leasing the magnificent quarters lately occupied by the General Electric Company, on Adams street, is busy preparing to occupy them by the first of the month. Here it will occupy three floors, and will carry the largest stock of electrical supplies handled in Chicago. This company is just at present particularly active in the introduction of its high grade of interior wiring specialties, believing that the best interests of the fraternity will be subserved by the people themselves setting the standard for excellence, without being forced to do so by the insurance authorities. Its metal-sheathed bushings are meeting with a great success. On all lines which it handles business is reported remarkably good.

News of the Week.

Telegraph and Telephone.

WASHINGTON, PA.—The Washington Telephone Company has been chartered. The incorporators are T. F. Birch, John R. Kuntz and W. C. Bryson, of Washington.

CAMERON, MO.—The Slater & Davis Telephone Company has offered to put in an automatic telephone service as soon as 20 subscribers are secured, the charges to be $18 per year.

BLOOMINGTON, ILL.—A local telephone company has been organized under the name of the Home Telephone Company, to build up a system to compete with the Bell company.

BUFFALO, N. Y.—T. J. Hurley, representing the International Telephone Company, which is headed by S. B. Elkins and others, has offered to install a telephone system at $36 per year for subscribers.

AUGUSTA, GA.—Manager McDonald, of the Telephone Exchange, is in receipt of instructions to at once begin work on rebuilding the exchange plant. District Foreman James A. Owens, of Atlanta, will have charge of the work.

PAWNEE CITY, NEB.—Frank E. Griffing, instructor in telegraphy at the Nebraska Wesleyan University, Lincoln, is urging the adoption of a telephone system, and will endeavor to have a meeting of business men to consider the project.

THE ALBANY TELEPHONE BILL.—The only incident of importance at the hearing on March 28 was an attack by some members of the committee on Secretary Gardner, of the New York Board of Trade, for proposing to raise money and organize in order to defeat legislators favoring the Bell Telephone Company. The counsel of the latter company denied that the telephone rate in New York is $240 per year.

Electric Light and Power.

SAUNDERSVILLE, GA.—Citizens are asking for an electric lighting plant.

CENTREVILLE, MICH.—Taxpayers have voted to issue $20,000 in bonds for an electric lighting plant.

MONTCLAIR, N. J.—The matter of an electric lighting plant has been referred to the law committee.

FLORENCE, COL.—The Council has granted a franchise for electric lights to S. F. Rathvon, of Denver.

FERTILE, MINN.—The village has voted to issue bonds for water-works and an electric lighting plant.

COLUMBIA, OHIO.—Citizens will vote in April on the matter of bond issue for an electric lighting plant.

BALTIMORE, MD.—The Legislature has refused to grant permission to Baltimore to erect a municipal plant.

SHELDON, ILL.—The village will vote on the question of issuing $6,000 in bonds for an electric lighting plant.

BLOOMDALE, OHIO.—C. B. Battrell and H. M. Hosler will soon begin work erecting an electric light plant.

HAMBURG, N. Y.—The Town Council has refused to increase the pay for electric light from $60 to $80 per annum.

NEWPORT, KY.—It is said that the electric light companies of Dayton, Covington and Newport will be consolidated.

CANAL FULTON, STARK COUNTY, OHIO.—Business men of Canal Fulton are agitating for an electric lighting plant.

BAINBRIDGE, N. Y.—An effort is being made to introduce electric lighting by the incandescent system into Bainbridge.

READING, PA.—An ordinance was introduced into the Council for a bond issue of $125,000 for an electric lighting plant, to be decided by special election June 12, but the matter has been referred to a special committee.

WAVERLY, OHIO.—Authority has been given the town to issue $15,000 in bonds for the erection of an electric lighting plant.

SHELDON, ILL.—The question of bonding the town for a $6,000 electric light plant will be voted on at the coming village election.

SAN ANTONIO, TEX.—The City Council has granted a franchise to F. J. O'Beirne to construct and operate an electric light plant.

BURLINGTON, VT.—The power house for electric light, near Winooski, has been badly damaged by fire, and Burlington is in darkness.

GEORGETOWN, OHIO.—A bill is before the Legislature authorizing Georgetown, Ohio, to issue $10,000 in bonds for an electric light plant.

ATLANTIC HIGHLANDS, N. J.—The application of George H. Stout, Jr., for a franchise for electric lighting, was laid on the table indefinitely.

ERIE, PA.—The ordinance granting a franchise to the Merchants and Manufacturers' Electric Light and Power Company has been passed finally.

JACKSONVILLE, FLA., intends installing a city lighting plant of its own, and will sell bonds for this purpose in April. the weather gets warmer.

CASSOPOLIS, MICH.—The Village Board has granted an electric light franchise to the Cassopolis Light and Power Company for a period of twenty-five years.

NEWCOMERSTOWN, OHIO.—The House has passed Mr. Tracy's bill, authorizing an issue of $15,000 in bonds by Newcomerstown to erect an electric lighting plant.

The Electric Railway.

HOT SPRINGS, S. D.—A franchise has been granted to J. M. Metcalf for an electric street railway.

ALLENTOWN, PA.—The Traction Company lines will be extended from Allentown to Easton, a distance of 15 miles.

SIOUX CITY, IOWA.—The Consolidation Company has bought the cable line, and will at once equip it with electricity.

BRIDGETON, N. J.—The large new brick car house of the South Jersey Traction Company has been blown down and a number of cars wrecked.

LEWISTON, ME.—The City Council will give a hearing April 12 to the petition of the horse railway company to change its motive power to electricity.

ROME, N. Y.—Officials of the Rome Street Railway Company are investigating into the matter of changing their motive power, but nothing definite has been done.

ALBION, N. Y.—It is stated that the Albion and Oak Orchard Railroad will be built standard gauge, with electric power for passenger traffic and steam for freight.

MIDDLETOWN, CONN.—The Council has granted permission to the street railway company to use the trolley system. J. M. Douglas is president of the company.

PORTSMOUTH, VA.—A syndicate of local capitalists has bought the Portsmouth Street Railway, and they will improve and extend the line, put on new cars, rails, etc.

READING, PA.—The Reading and Southwestern Railway has asked for permission to occupy certain additional streets, and the matter has been referred to the committee on railways.

NEWBURGH, N. Y.—The Common Council has granted a franchise to the Newburgh Electric Street Railway Company. Joseph H. Dickey is president and H. C. Norton is manager.

COLLEGE POINT, L. I., N. Y.—The application of the Whitestone and College Point Electric Railroad Company for right to lay tracks and operate a street railway will be given a public hearing on April 19.

BROOKLYN, N. Y.—The State Board of Railroad Commissioners has approved the application of the Brooklyn, Queens County and Suburban Railroad Company for leave to use the trolley system.

LAWRENCE, MASS.—The Lowell and Lawrence South Side Street Railway Company has been granted the right of way through Tewksbury, and will now press for entrances into this city and Lowell.

ELMIRA, N. Y.—On April 9 will be heard the petition of the West Side Railway Company for permission to build and operate a line on Miller street and other streets. Thomas Spence is city clerk of Elmira.

CHESTER, PA.—Eugene Harvey, Charles F. Wagner, Jr., John G. Dyer and William Wilson have applied for a charter for the Chester Traction Company, and they will be heard April 23. W. B. Broomall is solicitor.

GERMANTOWN, PA.—A permit has been granted to Contractor McCaul to erect a $17,000 car shed for the Germantown branch of the Philadelphia Traction Company, on Germantown road, above Church street.

Personal Notes.

GENERAL EDWIN SENECA GREELEY, the head of one of the oldest electrical supply houses in the United States, was born at Nashua, N. H., on May 20, 1832, and from that date to this his career has been one of universal success. His ancestors were of the North of Ireland stock, that settled in and around Londonderry, N. H. When about 12 years old his family met with reverses, and he found himself forced to earn his own living. For the greater part of three years he worked in a cotton factory. He had already developed an inclination for mechanical pursuits, being especially interested in locomotives. He therefore chose the trade of machinist, securing a position in Manchester. He became dissatisfied with that, and started for Schenectady, N. Y., where new locomotive shops had been built.

He obtained a position there, but later was employed in the Rogers Locomotive Works, at Paterson, N. J. In 1854 he visited New Haven, and was so well pleased with that place that he determined to make it his home, and shortly after he entered the employ of the New York and New Haven Railroad Company, where he remained until the outbreak of the Civil War. He was appointed First Lieutenant of a company in the Tenth Connecticut Volunteers, and immediately proceeded to the front. He remained in service throughout the war, repeatedly winning honors and being rapidly promoted, until in the early part of 1865 he was breveted Brigadier General. Returning in September of that year he soon formed a partnership with Mr. L. G. Tillottson, of New York, a practical telegrapher, who had recently retired from the railway and telegraph supply trade, but who wished to re-enter business in connection with some one who could furnish a personal knowledge of railway materials. The house of L. G. Tillottson & Co. became one of the oldest and most successful manufacturers and importers of railway and telegraph supplies. In January, 1885, Mr. Tillottson died, and his interest was acquired by General Greeley, who conducted the business under the name of E. S. Greeley & Co. until 1888, when it was reorganized as a joint stock corporation, and is known as "The E. S. Greeley & Company." At the beginning the capital was small and their facilities limited, but to-day their trade extends all over the civilized world. General Greeley has taken an active interest in electric lighting, and assisted in organizing the New Haven Electric Light Company and also the New Haven Car Trimming Company, of which he has been twice president. He is a director in various other manufacturing companies, and in the Yale National Bank. He is an active member of the G. A. R. and of the military order of the Royal Legion. Political honors he has steadfastly avoided.

MR. T. J. SMITH, the head of the electrical department of the E. S. Greeley & Co., is, through the course of training his career has given him, one of the most practical and successful handlers of electrical materials that the supply business has produced. Born in 1853, and consequently 41 years of age, he entered the electrical field before he entered his teens, in connection with the Commercial News Department, familiarly known in telegraph and commercial circles as C. N. D., several years before that department fell to the possession of the Western Union Telegraph Company. He was a telegrapher at 15, the manager of the Hoboken, N. J., office of the Western Union Telegraph Company at 16, and in his 21st year was in charge of the Panama Railroad telegraph office, the cable company's office at Panama, and held office under the Panama Government as instructor in telegraphy to the youth of the National College on the Isthmus. In 1876 he was a builder of telegraph and telephone lines in Spanish America, through which countries he publicly exhibited the phonograph, under commission from Thomas A. Edison, and introduced electrical apparatus of all description, from the electric light to the lightning rod, acquiring a knowledge of the people, their language and customs that has been of no small service to him in his subsequent work. He entered the employ of the E. S. Greeley & Co. just ten years ago in the capacity of city salesman, and there won such a position for

himself that upon the death of Mr. W. M. Goodyear, in 1889, he succeeded to the management of the electrical department. Mr. Smith is also a stockholder of some consideration in the E. S. Greeley & Co., and enjoys the distinction of being the youngest member on the board of directors.

Miscellaneous Notes.

A NEW STREET RAILWAY ASSOCIATION.—Representatives of the various street railways of Connecticut met at New Haven on April 3 and formed an association, which is to be incorporated as the Connecticut Street Railway Association. These officers were elected: President, H. Holden Wood, Derby; vice president, Henry S. Parmelee, New Haven; treasurer, E. S. Goodrich, Hartford; secretary, R. A. Fosdick, Stamford; executive committee, A. M. Young, Waterbury; G. A. W. Dodge, New Haven; Israel Kelsey, New Haven.

A COURAGEOUS LADY.—Last week while Mrs. Washington Roebling, of Trenton, was giving an entertainment in her house, she learned that workmen of a trolley road were erecting a pole in front of her grounds. Throwing a cloak over her shoulders she at once proceeded to the scene of action, where she arrived as a pole was about being erected. Upon the refusal of the foreman in charge to desist, Mrs. Roebling took her stand on the pole so that it could not be raised, and directed her servants to fill up the hole. The workmen then proceeded to dig another hole, whereupon Mrs. Roebling seated herself on a lawn settee placed over it, while her butler stood guard in the other hole. As the workmen commenced to dig a third hole a new plan of campaign was adopted, and presently a stream of water from a hose in the grounds temporarily dispersed the workmen, who, however, finally succeeded in erecting a pole about 4 o'clock in the morning, just before friends of Mrs. Roebling had succeeded in procuring an injunction.

Trade and Industrial Notes

THE MERIAM & MORGAN PARAFFINE COMPANY, Cleveland, Ohio, has issued a pretty miniature pamphlet containing a few weighty words, calling attention to its "Paragon" pitch, dynamo oils, and paraffine wax for insulating purposes.

THE BREESE & MANSFIELD COMPANY, electric railway engineers, Betz Building, Philadelphia, represents the Walker Manufacturing Company, of Cleveland, for the sale of electric street railway equipments.

THE GARTON-DANIELS ELECTRIC COMPANY, Keokuk, Iowa, has issued a 20-page catalogue, describing and illustrating the various forms of the Garton lightning arrester, and containing a number of exceedingly favorable testimonials as to its efficiency.

THE ST. LOUIS IRON AND MACHINE WORKS has issued a handsome 36-page catalogue, illustrating and describing the St. Louis Corliss engine. Owing to the clearness of the engravings and the detail in which they are given, the pamphlet will be a useful one to add to the collection of the engineer.

THE MICA INSULATOR COMPANY, 218 Water street, New York, has put in a telephone, No. 968 Cortlandt. Their numerous customers can now be in constant communication with them, and should they be in need of micanite, by simply ringing them up, they can have the material delivered promptly.

THE LODGE & SHIPLEY MACHINE TOOL COMPANY sends us a 44-page pamphlet containing illustrations, accompanied by concise descriptions, of machine tools for the rapid production of lathe work. Among the machines are a number of turret lathes, pulley lathes, boring, drilling, tapping and facing machines. A number of testimonials from prominent firms are also printed.

THE CARD DYNAMO AND MOTOR COMPANY, Cincinnati, Ohio, which has recently taken up the manufacture of street railway apparatus, has secured a very large order from the Consolidated Street Railway, of Cincinnati, and large orders from other roads, so that it has on hand at present orders for more than 100 street railway motors with the necessary apparatus to accompany them.

I. H. MOSES, 36 South Water street, Cleveland, Ohio, has issued a manual of telegraphy, which also contains a price list and catalogue of telegraph instruments and supplies. Among other useful information is a section containing answers to questions frequently asked by those intending to enter telegraphy or put up short lines, and prices and practical directions in regard to the latter are given.

THE BUCKEYE ENGINE COMPANY, Salem, Ohio, has recently sold engines to the following electrical plants: Ellsworth (Me.) Electric Illuminating Company, 180 h. p., high speed; Dayton (Ohio), Street Railway Company, three 500-h. p. tandem compounds, arranged for direct connection to Siemens & Halske generators; the McKeesport and Wilmerding Street Railway Company, McKeesport, Pa., 80 h. p., medium speed; Richmond (Ind.), Light, Heat and Power Company, two 300-h. p. medium speed tandem compounds.

WARREN WEBSTER & CO., of Camden, N. J., manufacturers of vacuum feed water heaters and purifiers, and oil and steam separators, report that the number of orders they received for the above named specialties during the month of March was very satisfactory, and showed a marked improvement over the few former months. They say that the reason their specialties sell during these times is on account of their goods being fuel-saving devices. Rapid progress is being made upon the new extension of their wrought iron department, connected with the new works, which they built last year.

THE BROWN ELECTRIC COMPANY, of Boston, Mass., one of the most enterprising supply houses in the country, announces a full-size complete telephone, with compound magnet, at a phenomenally low price that will undoubtedly attract quick sales, as it affords an opportunity of enjoying this modern necessity at a small cost. The Brown company announces also, that until it can catch up with orders, occasioned by the exceedingly large demand for these receivers, it will be obliged to fill all orders in rotation. Every instrument is guaranteed to be as perfect as any on the market, and the Brown company always stands behind anything it sells, and customers may depend upon receiving goods from it just as represented.

Business Notices.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

OPEN AND CLOSED CIRCUIT CELLS.—The Hayden carbon Porous cup No. 1 cell; the Hayden carbon porous cup No. 2 cell; a Leclanche clay porous cup cell; a standard Fuller cell; a No. 2 Fuller cell; a single cylinder carbon cell; a double cylinder carbon cell. All reliable and efficient and at prices lower than ever. THE HAYDEN-BOOKER MFG. CO., 2140 DeKalb St., St. Louis, Mo.

Illustrated Record of Electrical Patents.

U. S. PATENTS ISSUED MARCH 27, 1893.

(In charge of W. A. Rosenbaum, 177 Times Building, New York.)

Reissue. 11,408. ELECTRIC ELEVATOR; F. E. Herdman, Winnetka, Ill. Application filed Nov. 27, 1893. The combination of a switch, a second switch, a translating device, and circuit connections whereby upon closing by the first switch a circuit independent of the translating device, the second switch will automatically be operated to close the circuit of the translating device.

Reissue. 11,409. ELECTRICALLY OPERATED ELEVATOR; F. E. Herdman, Winnetka, Ill. Application filed Jan. 23, 1894. The combination of a worm shaft, a lever, one end connected to the shaft so as to move therewith, a tension device connected to the lever, and intermediate connection between the lever and the source of power, whereby when the movement of the shaft exceeds the tension device the lever moves over and shuts off the power.

517,017. INCANDESCENT ELECTRIC LAMP; R. P. Ashwell and G. W. Tuttle, Newark, N. J. Application filed Aug. 11, 1893. This comprises films reduced from a solution of paste of platinum chloride applied on the adjacent surfaces of the bulb and stopper, and solder of similar material uniting the films.

517,018. SECONDARY BATTERY; G. L. Ballard, Toronto, Can. Application filed April 27, 1893. This comprises a bridge or stand, a notch therein, and a plate provided with a foot adapted to enter the notch.

517,028. ELECTRIC RAILWAY TROLLEY; F. S. Church, Detroit, Mich. Application filed April 17, 1893. A trolley formed of two wheels, having complementary grooved beveled faces.

517,042. ELECTRODE FOR ARC LAMPS; S. Heimann, New York, N. Y. Application filed Sept. 15, 1893. An electrode composed of a mixture of powdered ashes, carbon and a binding surface.

517,069. ELECTRIC LAMP; F. C. Rockwell, Hartford, Conn. Application filed Nov. 6, 1893. An electric lamp receiver consisting of a transparent globe, and a base molded to fit the open mouth of the globe to which it is sealed, the base being grooved so as to render it elastic.

517,100. ELECTRIC SWITCH; J. S. Gibbs, Hartford, Conn. Application filed Oct. 4, 1893. This comprises a base with stationary contacts and a rotary handle spindle carrying a threaded nut, a block with conducting poles loosely connected with the nut, a lock on the base, and a spring for rotating the block when the nut is released from the lock.

517,105. ELECTRIC MOTOR OR DYNAMO ELECTRIC MACHINE; J. W. Henderson, Philadelphia, Pa. Application filed Nov. 1, 1890. The method of regulating an electric motor consisting of maintaining a constant field and varying the length of the wire on the armature inversely with the variations in the speed of the armature.

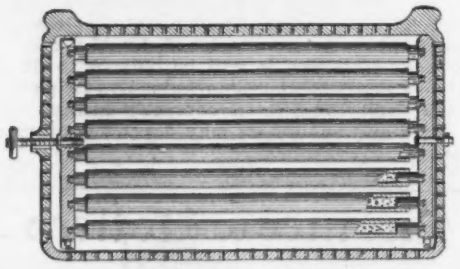
517,120. SAFETY CUT-OUT FOR ELECTRICAL APPARATUS; H. Lemp and M. J. Wightman, Hartford, Conn. Application filed July 31, 1886. This comprises the two poles of a circuit, an interposed mass of material which is normally an insulator, but which, when a current is passed over it, is heated and reduced to a conducting state, and forms a permanent bridge between the poles.

517,134. APPARATUS FOR SUPPLYING OR REMOVING STORAGE BATTERIES; W. E. Worthen, New York, N. Y. Application filed Aug. 5, 1893. The combination in a railway car having Bissell trucks, of a removable battery truck provided with wheels and carrying a storage battery and motor.

517,162. ELECTRICAL MEASURING INSTRUMENT; R. M. Hunter, Philadelphia, Pa. Application filed March 24, 1893. This comprises a stationary frame, a pivoted structure carried thereby, an expansible body connected at one end to the pivoted frame and at the other to the stationary frame, and over which an electric current to be measured is passed, a movable pointer connected with the pivoted frame, and a compensating body connected to the pointer and to the movable frame.

517,163. ELECTRICAL INDICATOR; A. E. Kennelly, Orange, N. J. Application filed Oct. 26, 1892. This comprises a magnet, disc armature situated flatwise between the poles of the magnet, and having a winding adapted to carry the current to be measured, and an indicating device moved by the disc armature.

517,166. TROLLEY CATCHER; L. G. Mowry, Buffalo, N. Y. Application filed Dec. 11, 1893. The combination with a pivoted depresser rod and its locking and releasing devices, of a trip cord connected with the trolley and an adjustable attachment connecting the trip cord with the depresser rod.



NO. 517,170.—ELECTRIC HEATER.

517,169. ELECTRIC APPLIANCE FOR DUMB WAITERS; J. H. Roberts, Brooklyn, N. Y. Application filed Sept. 11, 1893. This comprises electric switches in the path of the waiter combined with a reversible rheostat, a switchboard adjacent thereto, switch arms theron operable from the rheostat, and conductors from the switch-board to the rheostat and the switches.

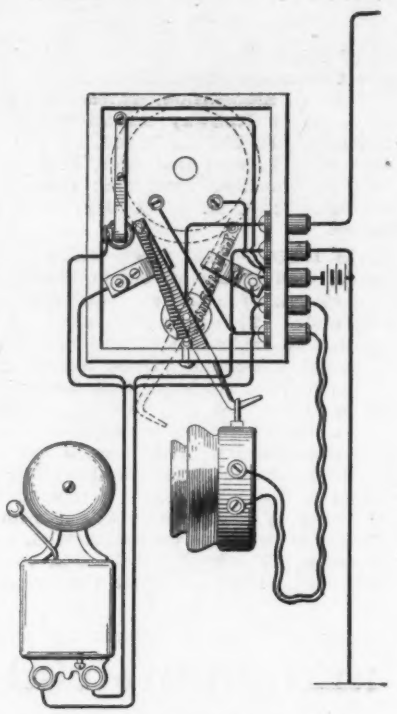
517,170. ELECTRIC HEATER; L. B. Rowley, Ashland, Wis. Application filed Jan. 28, 1893. This comprises a plurality of tubes of non-conducting material, electrical resistances therein, plugs closing the ends of the tubes and in contact with the resistances, and two metallic plates, one located at each end of the tube and in contact with all the plugs, one of the plates being mounted upon rollers and provided with means whereby it may be moved for the purpose of varying the resistance of the material within the tube. (See illustration.)

517,199. VALVE; J. E. Stannard, Springfield, Mass. Application filed July 24, 1893. The combination with a casing having a main passage and lateral extensions, of a valve and valve piston reciprocating in the extensions, the valve comprising a slotted hollow cylinder having a central internal extension.

517,243. SINGLE LINE TELEPHONE SYSTEM; J. I. Sabin and W. H. Hampton, San Francisco, Cal. Application filed March 13, 1893. This comprises a line, an operator's telephone normally in connection therewith, and means at the subscriber's station whereby he may include his telephone set in circulation with the operator's telephone.

517,253. GALVANOMETER; E. G. Willyoung, Philadelphia, Pa. Application filed June 23, 1893. This comprises a controlling magnet, and two adjustable tubular parts combined with a core upon which are fitted the tubular parts and in which the tubular parts are adapted to be simultaneously moved upon or off the core part to vary the magnetic lines of force, and in which the movable tubular parts are relatively magnetic to the core, or vice versa.

517,528. ELECTRICAL RAILWAY; B. Bidwell, Philadelphia, Pa. Application filed Jan. 8, 1885. This comprises a line of conductors, a loop in the generator circuit having telephonic instruments and resistance coils, in combination with a car having a traveling circuit connector, a motor circuit and a loop from the motor circuit, and including a telephonic instrument and resistance coils.

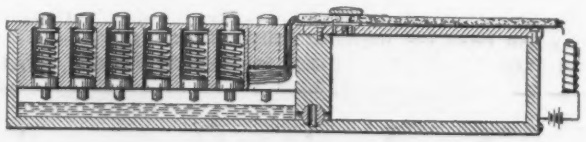


NO. 570,263.—TELEPHONE SWITCH.

517,263. TELEPHONE SWITCH; F. R. Colvin, New York, N. Y. Application filed Dec. 6, 1893. A switch provided with a tilting hook for the telephone, the free end of the hook normally pointing upward, the angle of tilt to shift the switch being sufficient to cause the hook to point downward to shed the telephone. (See illustration.)

517,276. METAL COVERED ELBOW; E. T. Greenfield, New York, N. Y. Application filed July 14, 1891. An elbow made of insulating material and a close fitting surrounding metallic jacket or sleeve.

517,299. ELECTRIC CALLING APPARATUS; D. H. Rice, Brookline, Mass. Application filed Feb. 11, 1892. This comprises a converter having an annular core with a segment cut out of it and a metal block fitted thereto, and arranged to complete the core, an armature connected with the block, and a magnet in the secondary circuit of the converter, arranged to lift the armature and withdraw the block, when the electric current generated by the converter exceeds a predetermined strength.



NO. 517,402.—ELECTRICAL KEYBOARD.

517,402. ELECTRICAL KEYBOARD; C. E. Allen, Salem, Mass. Application filed Dec. 29, 189. A key support for electric key boards consisting of a non-conducting plate provided with parallel rows of chambers and grooves or channels in the plate between the rows of the chambers. (See illustration.)

517,401. CIRCUIT CLOSER; C. E. Allen, Salem, Mass. Application filed Dec. 29, 1893. This comprises a key or push button and a mercury contact therefor, whereby a continuous metallic circuit can be obtained.

517,419. ELECTRICAL APPARATUS FOR CONTROLLING SIGNALS; M. B. Leonard, Richmond, Va. Application filed June 17, 1893. This comprises a visual signal at each station and means for locking the same in normal position, unlocking magnets, a normally grounded wire extending between the stations and including the magnets, a local battery at each station, and means for transferring the ground connection to either of the local batteries so as to include the distant unlocking magnet and release the distant signal, and an electric motor adapted to automatically shift the signals when released.